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CHOOSE THE BEST ROUTER FOR YOUR NEEDS p.48

ISSUE 170 JUNE/JULY 2006

Better Homes and Gardens®

WOOD®

The Shop-Proven Woodworking Magazine

Build this super-easy Garden Bench

p.40

6 Fun Ways to Become a Better Woodworker p.84

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- Hummingbird Feeder p.80
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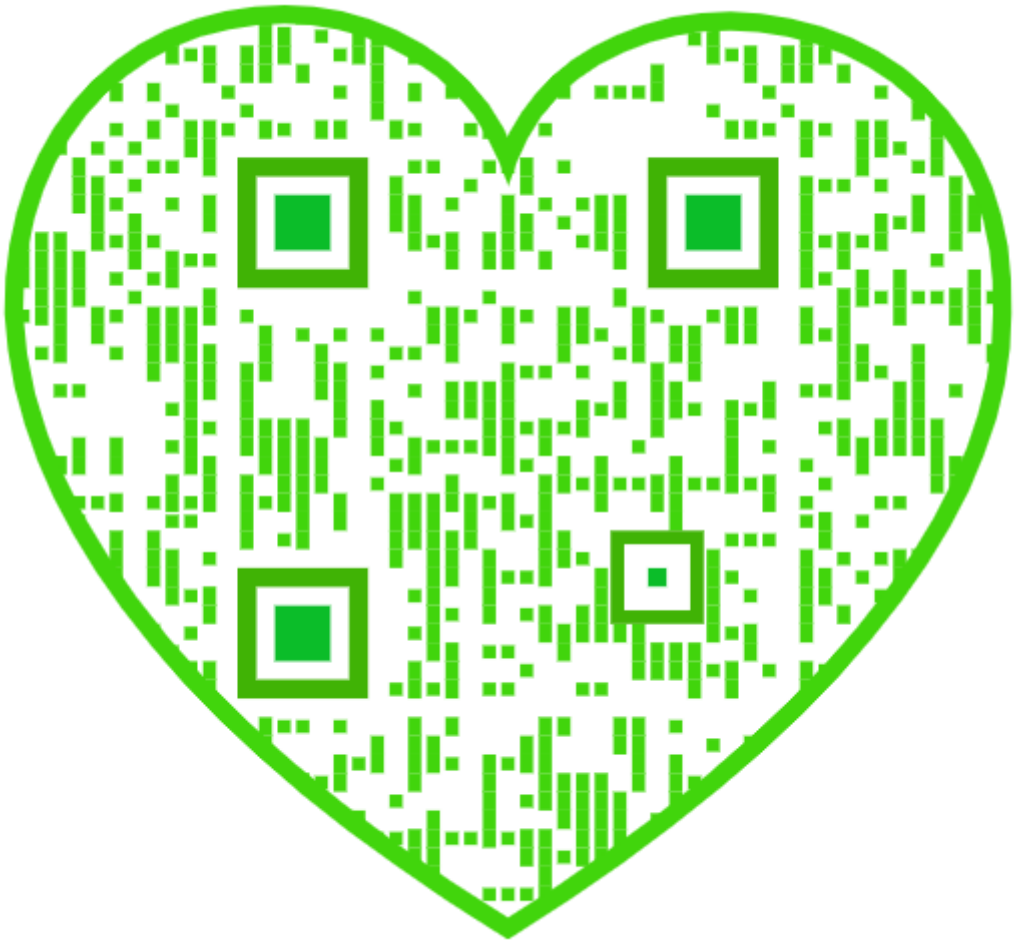

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June/July 2006 | Vol. 23, No. 3 | Issue No. 170

Kevin designed and built this contemporary table.

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Marlen's passion for turning has led him to turn hundreds of vessels.

Jim built the sleigh bed from issue 135 for his daughter and son-in-law.

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In Memoriam — E.T. Meredith III (1933–2003)

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WOOD®

June/July 2006, Issue 170

WOOD MAGAZINE SHOP TESTED APPROVED®

This seal is your assurance that we build every project, verify every fact, and test every reviewed tool in our workshop to guarantee your success and complete satisfaction.

PROJECTS

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Make a safe place to stand your router while its bit slows to a stop between work sessions.

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Buy the trim, fixed-base, or plunge router in the power range that best suits your needs.

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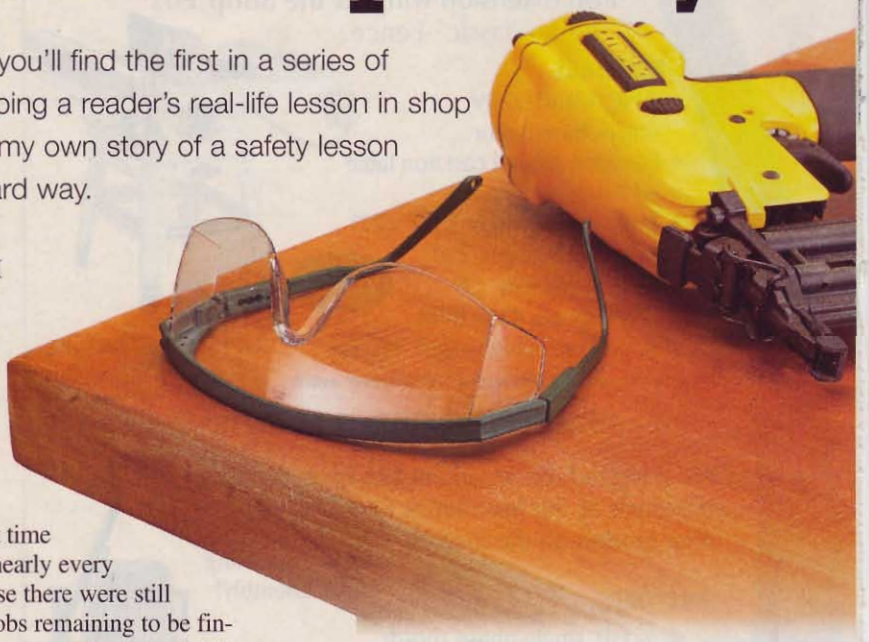
editor's angle

keeping an eye on workshop safety

On *page 104* you'll find the first in a series of articles describing a reader's real-life lesson in shop safety. Here's my own story of a safety lesson learned the hard way.



Last spring I was busy readying my family's 1925 bungalow for sale. After 17 years and three kids, we just outgrew the place. During that time I had remodeled nearly every room, but of course there were still numerous small jobs remaining to be finished before we could put the "For Sale" sign in the front yard. On one such job, I was attaching some moldings with a pneumatic brad nailer. Normally, I wear contact lenses and safety glasses, but that morning I left the contacts out and was wearing my eyeglasses. And those provided the necessary eye protection, right? Well, not quite.

It all began when a fired brad hit something hard behind the molding and didn't go all the way in. So I reached for my wire snips to clip off the protruding ¼" or so of brad prior to countersinking what remained with a nail set. As I snipped the head off the brad, I didn't look away, figuring my eyes were protected behind the glasses. Big mistake. I felt something hit my left eye and then spotted two drops of clear fluid on the inside of my eyeglass lens. Uh-oh.

The bit of snipped-off brad managed to fly through the tiny gap between the bottom of my glass lens and my cheek and strike my cornea. I felt okay, could see fine, and found the snipped brad head on the floor—so I knew it wasn't lodged in my eye. Still I thought it best to visit my ophthamologist to make sure everything was really okay.

The eye doc told me I was a very lucky man. The errant brad head had lacerated the cornea, and the flap it cut self-sealed after the brad piece bounced out of the eye. Had the eye leaked more, or had the tiny piece of metal penetrated deeper, things could have been much worse.

The motto of my real-life lesson in safety: Eyeglasses are not sufficient eye protection. Not only do they have openings all around them that debris can sail through, they're also not made of shatterproof materials. Their lenses could damage your eyes if they shattered upon impact with any kind of fast-moving object.

So whenever you're working with power tools or doing anything that sends debris flying, *please* wear comfortable, snug-fitting, shatterproof safety glasses. They're cheap protection for the only eyes you'll ever have. I learned that the hard way, and pass on the incident here so you don't have to.

Bill Krier

sounding board

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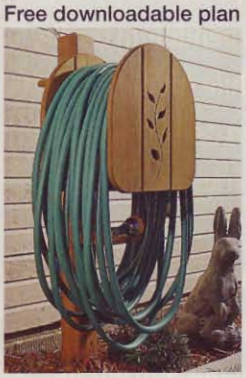


This cedar hose holder couples utility with style.

Tool sweepstakes prize

For **MAY**

Delta's 12" Twin Laser Mitersaw shows both sides of the cut.

Free downloadable plan

Climbing plants take quickly to this tuteur.

Tool sweepstakes prize

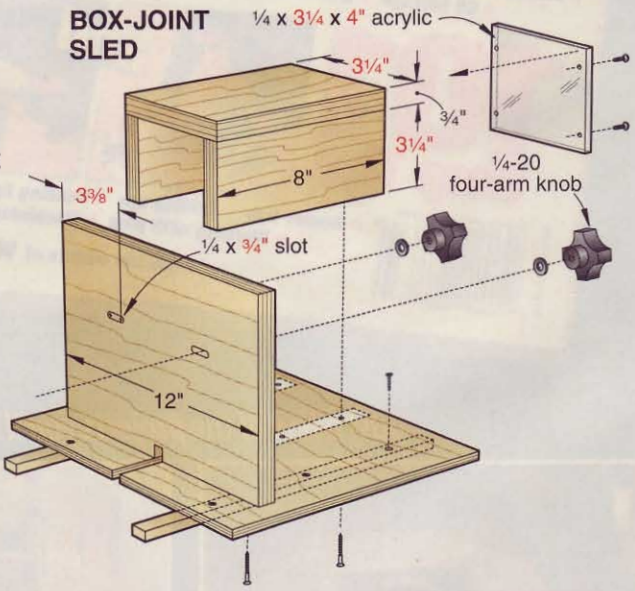
For **JUNE**

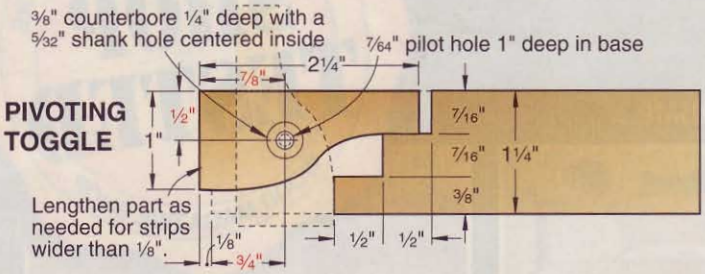
This Bosch router table has dust ports on the fence and cabinet.

Article updates

February/March 2006, issue 168

- On page 14, the left-hand label on the lower left jointer photo should read "infeed table"; the right-hand label, "outfeed table."
- The width of the blade guard and acrylic on the box-joint sled on Drawing 1 on page 55 is 3¼" wide to allow for the rotating of the four-arm knobs as shown *right*. Note also the adjusted slot length and location in red type.
- The hole through the pivoting toggle in Drawing 4a on page 57 should be located as shown *below*.





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ask wood

Answers to your questions from letters, e-mails, and WOOD Online®

Tapered tenons

Q: Recently, I had to cut ½"-thick, 2½"-long tenons in ¾" oak for a project. Each time, the results were a disaster with tenons measuring 9/16" thick nearest the shoulders and 7/16" thick at the tip. I'm using a Delta tenoning jig and a thin-kerf blade that may deflect. Can you help?

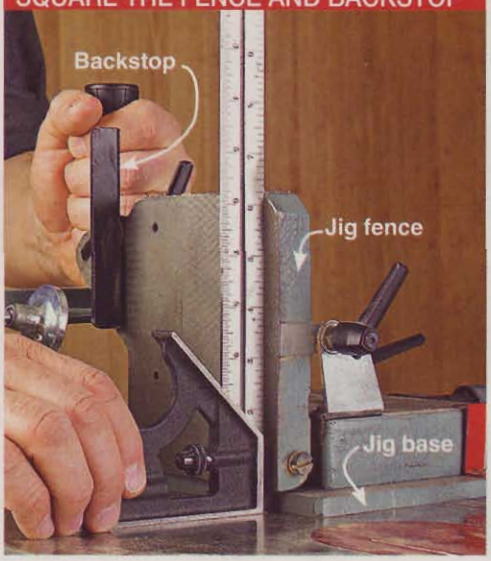
—Bob Van Zandt, Lebanon, Ohio

A: That thin-kerf blade could be part of your problem, Bob, but first let's eliminate the other possible causes. Start by confirming that you've adjusted the blade 90° to the table top, as shown at *near right*, not to the throat plate. Don't just rely on the 90° bevel stop, which can become contaminated with sawdust and throw off the blade angle.

Now let's focus on the jig. Adjust the tenoning jig fence 90° to the saw table, as shown *below right*, and be certain any workpiece clamped against the fence doesn't accidentally touch the jig base. To keep your workpiece from tilting, adjust the backstop 90° to the table top. If you've followed these tips and the jig's directions but you're still having problems, try switching to a full-kerf blade. These thicker-bodied blades deflect less than thin-kerf ones.

SQUARE THE BLADE TO THE SAW TABLE

SQUARE THE FENCE AND BACKSTOP



Bamboo basics

Q: I make bases for trophies and backs for clocks using laminated bamboo, which I purchase as kitchen cutting boards about 1" thick. I find it very attractive and inexpensive. Is it available in lumber form from wood suppliers, and in what thicknesses and widths? Also, can you tell me more about its properties and recommended finishes?

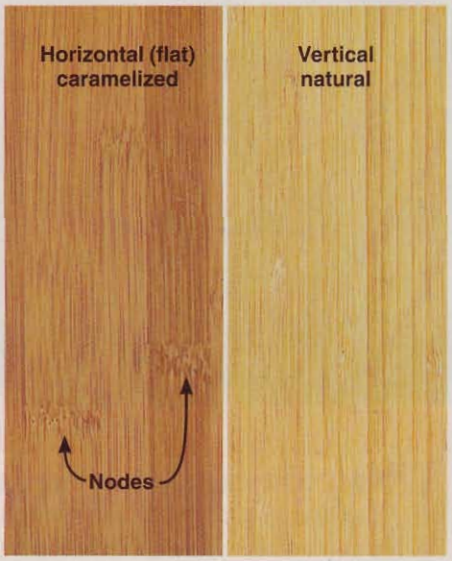
—Ron Whiteley, Port Credit, Ont.

A: Bamboo—not really a wood, but a fast-growing grass—can be laminated to make everything from veneers to ply panels and dimensional stock comparable to sawn lumber, Ron. Bamboo strips cut from the stalk are laminated one of two ways, shown at *right*: horizontally (also called "flat") or vertically. The horizontal pattern uses strips resting flat on their faces, showing the nodes from the stalk. Uniformly spaced lines indicate a vertical lamination. Bamboo comes in its natural pale blond color or with a light brown tint formed when the strips become caramelized during the lamination process.

Your biggest obstacle may be finding bamboo in sizes large enough for your projects. A good source for bamboo "boards" may be your local flooring dealer. For panels and wider stock, try a mail-order supplier. The samples shown here came from Northwest Bamboo (503/695-3283 or nwbamboo.com), which provides solid laminations up to 12×96×1 1/16" for stair treads, veneers in 4×8' sheets, and a variety of cross-laminated ply panels in ¾" and three-ply panels ¼" thick.

Bamboo machines much like moderately dense hardwoods, but the long, thin fibers tend to break off easily at the ends when crosscut. Back up all of your cuts, and lay a sacrificial piece of scrap on top of the line when you make crosscuts to help reduce tear-out. Though not heavy, bamboo is hard enough that it needs to be routed using quick passes to avoid burns. Sanding up to 180-grit levels the many thin, hard fibers to produce a smooth surface. Watch out for bamboo's small, sharp splinters.

Oil-based stains can be used on bamboo without blotching, although the texture traps stain pigments to create a busy but even pattern. For more uniform color, use a water-based dye. All film finishes are suitable for bamboo.



continued on page 16

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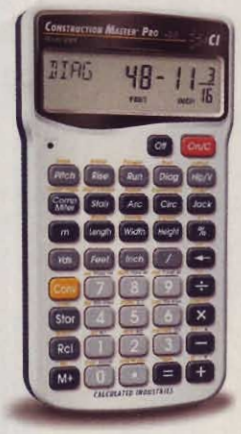

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Try climb-cutting for more smoothness

Q: Some articles on router techniques advise against climb-cutting, but then say it can produce excellent results. What exactly is climb-cutting, and how can I determine when to use it?

—Joe Bogatich, Akron, Ohio

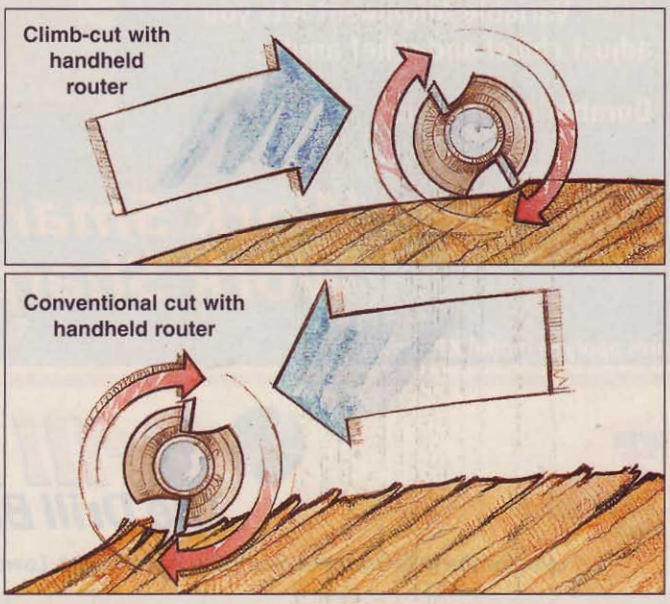
A: Joe, climb-cutting is when you feed your work into the router bit with, instead of against, the rotation of the bit. It'll feel like the router is pulling itself along the edge of the wood, which is how the technique gets its name—the bit pushes itself away from the edge of the board and climbs out of the cut. When you're using a hand-held router along the edge of a board, for example, moving the router from left to right is a climb cut. To climb-cut on a router table, feed the workpiece from left to right.

While the standard feed direction produces faster cutting, it sometimes becomes too aggressive and tears out chunks of wood when the bit lifts up the grain. But when you combine a climb direction with a shallow cut and a light touch, tear-out is far less likely, even with woods that have unruly grain patterns. Some woodworkers use climb cuts in several passes to take off small amounts of wood along areas with tricky grains that are likely to tear out. Following up a climb cut with a conventional pass at the same depth setting smooths any unevenness left behind by climb-cutting without removing an additional layer.

A few words of warning: Although you can safely climb-cut with small-diameter bits at the router table, NEVER attempt a climb cut with a large one, such as a panel-raising bit. The surface of the profile is what matters, but a ½" quarter-round bit is as large as you'd want to use. Also, NEVER attempt a climb cut with a shaper cutter. When using a router table, remember that it's the tendency of a climb-cut to pull your hands toward the router bit, so position your hands carefully and away from the bit.

Got a question?

If you're looking for an answer to a woodworking question, write to **ASK WOOD, 1716 Locust St., LS-221, Des Moines, IA 50309-3023** or send us an e-mail at **askwood@woodmagazine.com**. For immediate feedback from your fellow woodworkers, post your questions on one of our woodworking forums at **woodmagazine.com/forums**



our editors test compact compressors

Why buy?

Pneumatic brad nailers are gaining popularity in the workshop, due to their usefulness and dropping prices. But unless you're also going to spray finishes—a task that requires a powerful, 60- to 80-gallon compressor—you don't need a compressor that delivers a lot of airflow. Just 90–100 psi, one "pop" at a time, will do it. But four-gallon models, weighing in at 50–70 lbs, are "portable" only by job-site standards. That's why some manufacturers now offer a new breed of compact, oil-free air compressor. These tiny units weigh less than 20 lbs, yet pack enough punch to power a nailer or inflate a truck tire.

Bostitch CAP1516, $180

Weight: 19½ lbs;
footprint: 11×19"

Editor test-drive:

While trimming out a bedroom, I found that the CAP1516 consistently drove twelve 18-gauge brads at 90 psi before the compressor kicked in to replenish its 1.6-gallon air tank. To reach the low-mounted pressure gauge and regulator knob, the unit stands on its rear end. So I simply rocked it back, tweaked the pressure, and rocked it forward onto its rubber feet. The regulator turns easily but, situated in a niche in the unit's plastic shell, provides only a fingertip grip—coarser knurling would help. With its 116 psi max pressure, this compressor had no trouble driving brads and narrow-crown staples, nor filling tires or sports balls. Dusting off small projects and power-tool motors went well, too, but for large projects, the pressure fell off quickly and the motor ran constantly.

The CAP1516 sports two carrying handles, one on the top and the other beneath the front edge. Molded cleats on the bottom of the unit make for convenient cord storage. And, unlike every other compressor I've owned, the tank draincock is easy to access and turns without having to break out the pliers.

—Tested by Jan Svec, Projects Editor

To learn more:

800/556-6696; bostitch.com

Senco PC1010, $115

Weight: 18 lbs;
footprint: 13×14"

Editor test-drive:

At first glance, the PC1010 looks like a toy, but this is one serious little compressor. I tested it with a full complement of air-powered tools, from my 15-gauge framing nailer to a 23-gauge pinner, and it had no trouble driving any of those fasteners into poplar, although it couldn't keep up with a rapid-fire pace. (The motor fired up to refill the 1-gallon tank after only five brads, and when punching them in quick succession, ran out of air after about 20.)

I used this unit to tackle a "honey-do" list of chores I'd put off because I didn't want to drag my 4-gallon compressor around the house. I strolled from room to room tacking up molding and casing with ease.

Back out in the shop, the PC1010 has found a semi-permanent home on the corner of my bench; at that height the top-mounted controls are still readily accessible, and so is the tank's draincock. The operating noise is acceptable, running noticeably quieter than my shop vacuum. This compact compressor sure convinced me that bigger isn't always better.

—Tested by Chuck Hedlund, Master Craftsman

To learn more:

800/543-4596, senco.com

Campbell Hausfeld FP2028, $50

Weight: 12 lbs;
footprint: 10×10"

Editor test-drive:

I was pleasantly surprised by the FP2028's performance, especially given its low price. After coupling my brad nailer to the 25' coil hose that came with the unit, I started tacking up molding, driving eight 1¼" brads in less than 40 seconds. Next, I went out to the shop and punched 2" brads into 2×4 scraps as fast as my nailer would allow. After 15 fasteners in a row, this little unit, with its 1-gallon tank, could no longer keep up—pretty impressive for a compressor that cost half as much as my nailer.

Moving to a different assignment, I blew dust off a jewelry box before applying finish, and found that the FP2028's airflow quickly became too weak. It's definitely not a high-volume model, but more than sufficient for weekend woodworkers and DIYers who need to power a pneumatic nailer. It also comes with a sport-ball needle, two plastic inflation nozzles, and a tire chuck. One quibble: With no pressure adjustments, the compressor always pumps out 100 psi, so you can't dial it down to use with a hobby airbrush, for example.

—Tested by Jim Harrold, Executive Editor

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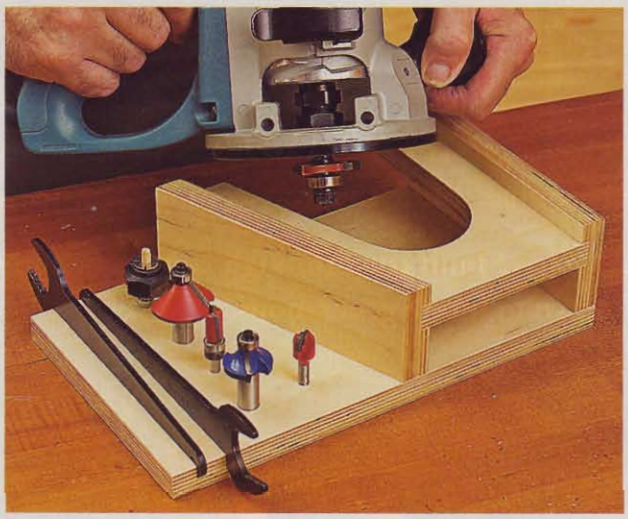
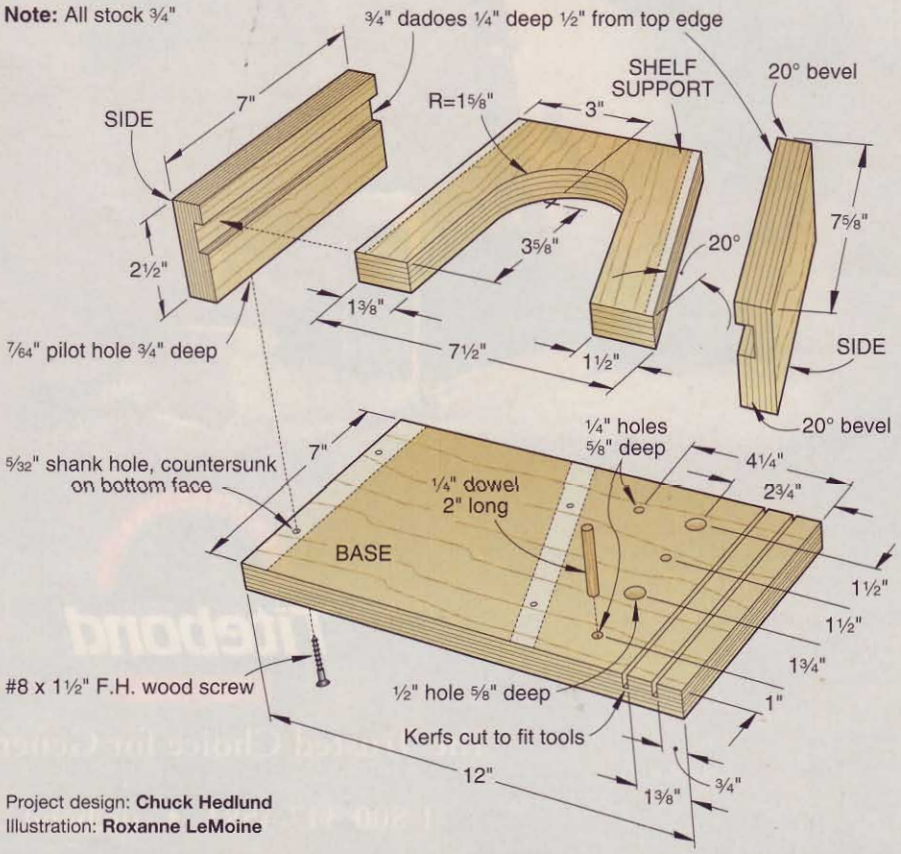


Wasting valuable time waiting for your router bit to stop spinning before you set the router down? Would you like your router wrenches and bits near the project you're working on for a speedy change? Solve both concerns by building this handy plywood router caddy. Place your powered-down router into the U-shaped opening in the shelf support to shelter the still-turning bit safely away from both your worktop and your hands.

To build this simple project, cut the pieces to the sizes noted on the drawing *below*. Then, cut or rout a ¾" dado ¼" deep in the side pieces where shown. Drill the router-bit shank holes, and cut the kerfs in the base to customize it to organize your bits and wrenches. Drill countersunk mounting holes, and assemble the pieces. A short section of dowel in the base works nicely to hold an extra collet. Add a clear finish, if desired.



Project design: **Chuck Hedlund**
Illustration: **Roxanne LeMoine**

shop tips

Helping you work faster, smarter, and safer

A mini bar clamp with a delicate touch

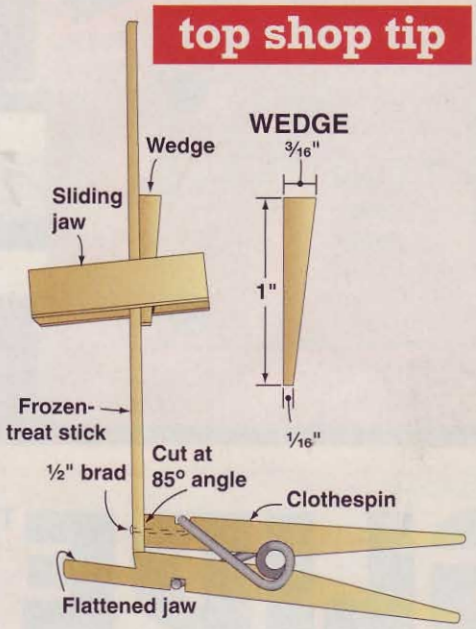
For small or fragile glue-ups, such as dollhouse furniture or models, spring-type clothespins provide the right amount of clamping pressure. Problem is, the jaw opening is often too small. To solve this problem, I altered a wooden clothespin to make a mini adjustable bar clamp.

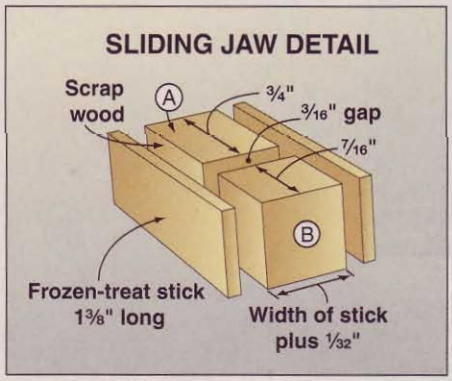
To make one for yourself (I make at least six at a time), begin by cutting the clothespin jaws, where shown *below*. Next, attach a frozen-treat stick to the clothes-pin's upper jaw with a brad nail and glue. Be sure to predrill the brad-nail hole to avoid splitting. Finally, glue the sliding jaw parts together, as shown in the Sliding Jaw Detail.

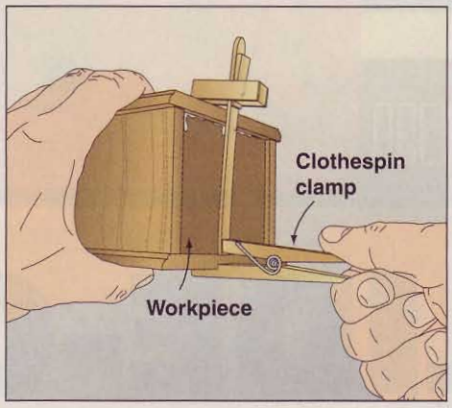
To use the clamp, simply slide the jaw to the desired opening, and secure it to the frozen-treat stick with the wedge. As shown, the mini bar clamp can hold assemblies up to 4" thick.

—Bob New, Cockeysville, Md.

top shop tip



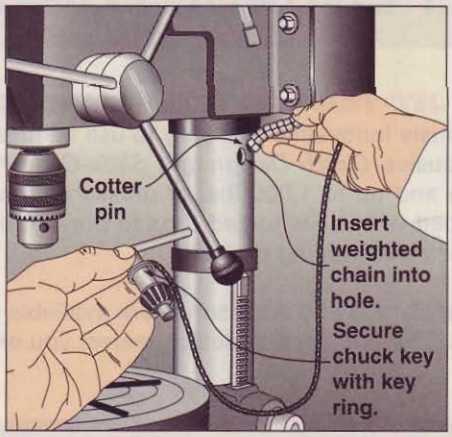




Self-winding leash for wandering chuck keys

I got tired of hunting for my drill press's chuck key, so I gave it a permanent home. I drilled a 5/8" hole near the top of the column, as shown at *right*. Next, I slipped a dozen or so 1/4" nuts over a 24" length of sash chain, using a cotter pin as a stop for the nuts. Finally, I attached the other end of the chain to the chuck key with a key ring, and then dropped the chain and nuts into the hole.

—David Schneider, Kitchener, Ontario



Our Winner

Photo: Kristine Buls

Think of Bob New as a 21st-century renaissance man, constantly learning and mastering new skills. After owning four Baltimore-area restaurants, he got serious about woodworking and decided to try his hand at crafting violins, dulcimers, and mandolins. "I can't play them, but in skilled hands they sound great," our Top Shop Tip winner quips. Bob has been spending less time in the shop these days as he finishes up writing his first novel—a mystery—at age 73.

Bob will sand violin parts easier with the Jet 10-20 Plus drum sander we're sending him for submitting the Top Shop Tip.

Top tips win tools!

Describe how you've solved a workshop puzzler, and you'll earn $75 if it appears here. And if your tip garners Top Shop Tip honors, you'll also win a tool prize worth at least $250.

Send your best tips, along with photos or illustrations and your daytime phone number, to: **Shop Tips, WOOD Magazine, 1716 Locust St., LS-221, Des Moines, IA 50309-3023**. Or e-mail tips to shoptips@woodmagazine.com. Remember to include your contact info in the e-mail as well.

Because we publish only original tips, please send your tips only to *WOOD*® magazine. Sorry, submitted materials can't be returned.

continued on page 24

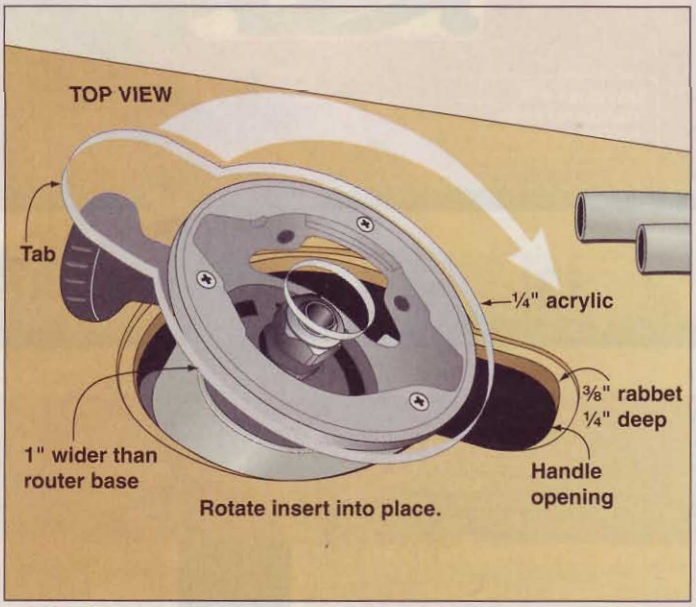
A clearly superior subbase for routers

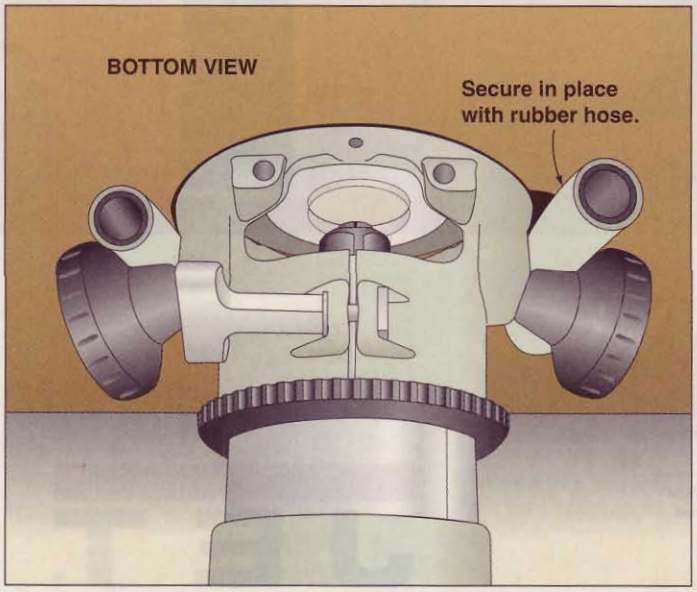
My shop-made router table has one big advantage over other tables—I don't have to remove the subbase when changing between freehand work and table work. That's because the ¼" clear acrylic subbase I made for handheld use also sits securely in a ⅜" rabbet ¼" deep in the router table opening.

Make the base plate 1" larger in diameter than the router base and add a tab at least ½" wider on all sides than the side handles, as shown. (This tab makes it possible to insert the router from above and keeps the router itself from spinning.)

When mounting the base plate, be sure to align the tab directly underneath one of the handles. To install the router in the table, drop the uncovered handle through the handle opening, and then spin the router 180° to align the base plate. Secure the router in place with short lengths of rubber hose jammed between the handles and the underside of the table.

—Robert Martin, Picture Butte, Alberta



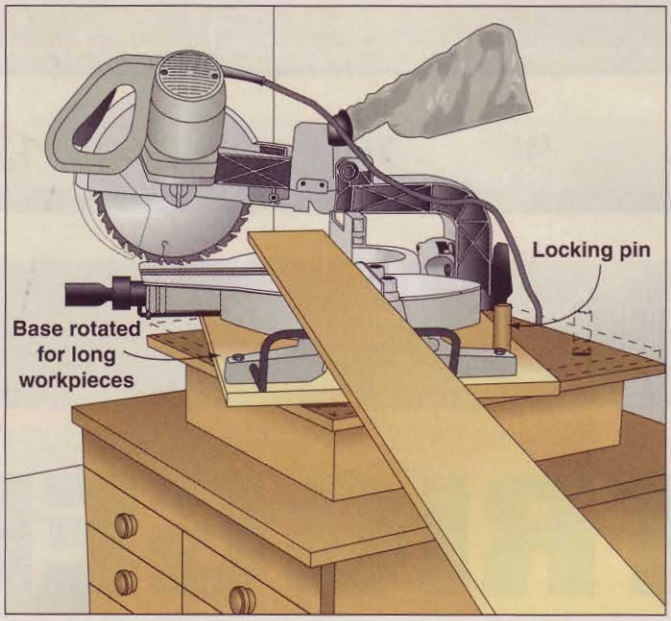


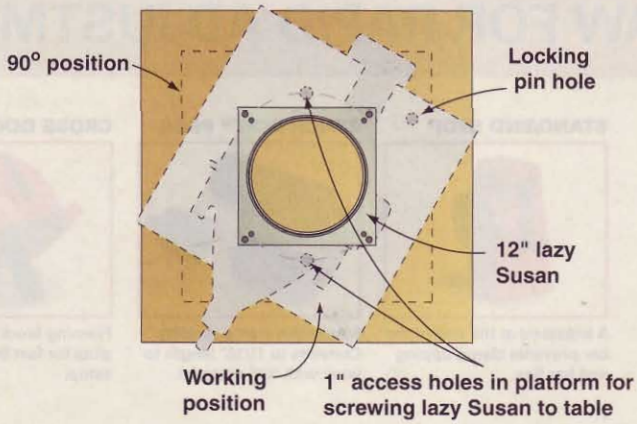
Swivel base for mitersaw simplifies setup

We've all been there. You need to cut a long workpiece on your mitersaw. But when you try to position it against the fence, it bumps into something. Nudging the saw a bit forward, you hit something else. Finally, frustrated, you pick up the heavy saw and set it up where the workpiece will clear all obstacles. To avoid heaving my mitersaw around when cutting long boards, I created a simple swivel base that dramatically increases my cutting options without relocating the saw.

The swivel base consists of two pieces of plywood with a lazy Susan sandwiched between. To install the lazy Susan, first drill access holes in the saw platform that will line up with the screw holes of the lazy Susan. Attach the lazy Susan to this platform, and then mount the lazy Susan to the base cabinet or benchtop. With the sandwich complete, mount the saw on top of the swiveling platform. To lock the base square to the wall, or angled left or right, drill holes in the platform and cabinet base where needed for maximum clearance, and then drop in a dowel as a locking pin, as shown.

—Bruce Gillette, Paradise, Calif.



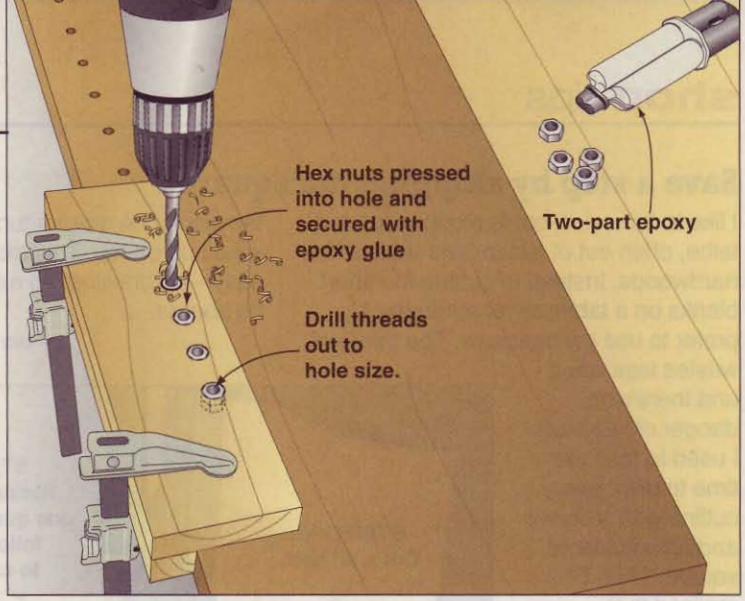


Made-to-order shelf-pin jig

I've seen any number of shelf-pin drilling jigs in woodworking catalogs. Problem is, most are limited with respect to hole sizes and spacing. That's why I like to make my own from scrapwood, hex nuts with a raised thread diameter slightly smaller than my desired hole, and epoxy.

After making the base of the jig from scrapwood, as shown at *right*, counterbore a hole into the top of the jig deep enough for two stacked nuts, and then epoxy the nuts into the hole. Let the epoxy cure completely and drill through the nut threads, epoxy, and wood with the desired bit size. The jig will help you hand-drill hundreds of holes before the nuts wear out, and when they do, you can cheaply replace them.

—Frank Penicka, Mount Pearl, Newfoundland

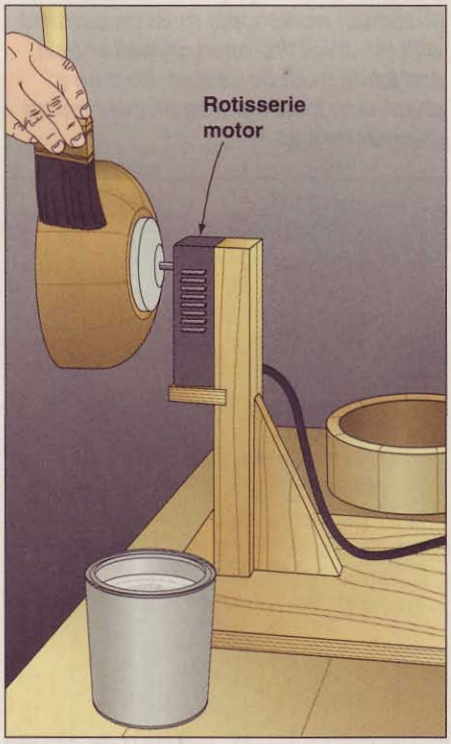


continued on page 26

Spin your lathe turnings to a flawless finish

When applying finish to my lathe turnings, I always seemed to get a drip or run no matter how careful I worked. I decided the solution was to keep the workpiece spinning. To accomplish this, I made the stand shown, and mounted a barbecue rotisserie motor to it. I then installed a face plate on the motor's shaft to hold the workpiece. The motor rotates the spindle at approximately 6 rpm, and the piece can be left turning as it dries without fear of runs.

—Byron Manthey, Hutchinson, Minn.



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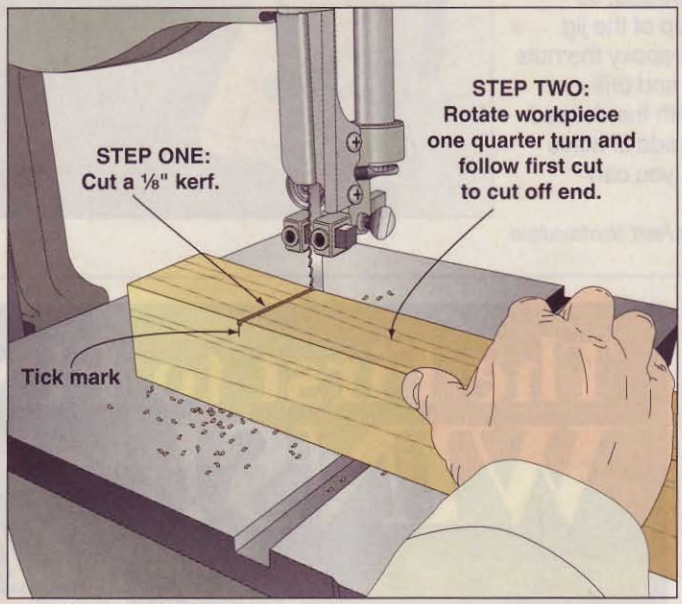
Circle No. 141

Save a step by skipping the square

I like to turn wine-bottle stoppers on my lathe, often out of exotic (and expensive) hardwoods. Instead of cutting the short blanks on a tablesaw or mitersaw, I prefer to use my bandsaw: The thin kerf wastes less wood and there's no danger of kickback. I used to take the time to draw every cutline with a pencil and an adjustable square. Then I realized that, because the bandsaw table is at 90° to the blade, all I really needed to do was make a small tick mark with my pencil and cut a shallow kerf on the face of the wood to mark the cutline. Then to make the cut, I simply rotate the stock one quarter turn so the cutline winds up on top. This method is fast and easy—no drawing, no miter gauge, and no square.

—Jim Vasi, Williamsville, N.Y.



Wooden "power strip" simplifies shop walls

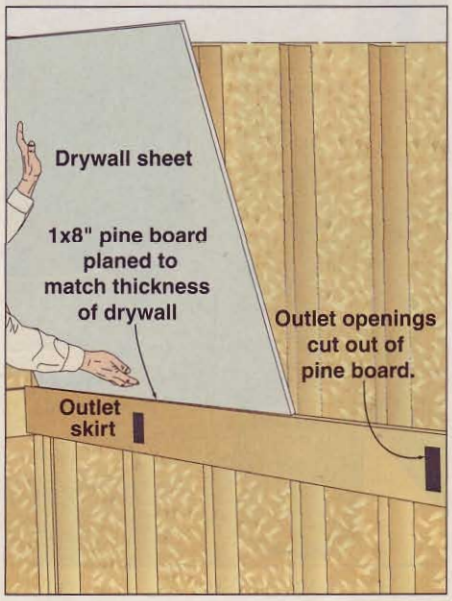
When I added a workshop to my house, I wanted the interior to look finished, but I know how hard it is to get the holes in exactly the right spot for the utility boxes. I also worried about handling the heavy sheets to cover the walls. I solved both problems with an outlet skirt, as shown, mounted with its bottom edge about 48½" above the floor.

Before installing the skirt, I planed the boards to the same thickness as my sheeting, and cut holes for the outlet boxes. I could put an outlet box hole anywhere along the skirt's length, as long as I didn't line it up on top of a stud.

With the skirt in place and the shop wired, I used it as a support ledge while I attached the upper sheets, and I didn't have to cut any utility box holes in the drywall. While I'll admit this is an unorthodox solution, it helped save my back. And I like the look of the separate skirt so much that I painted it a different color than the walls.

—Jerry Bittner, Jacksonville, N.C.

Editor's Note: *Local building codes govern the types of sheeting that can be used to cover workshop/garage walls and ceilings that are shared with living spaces. In most situations, shared walls and shared ceilings (in the case of basement workshops) must be covered with ⅝"- thick fire-rated drywall sheets, and joints must be sealed. Be sure to check with local building officials before using Jerry's tip.*



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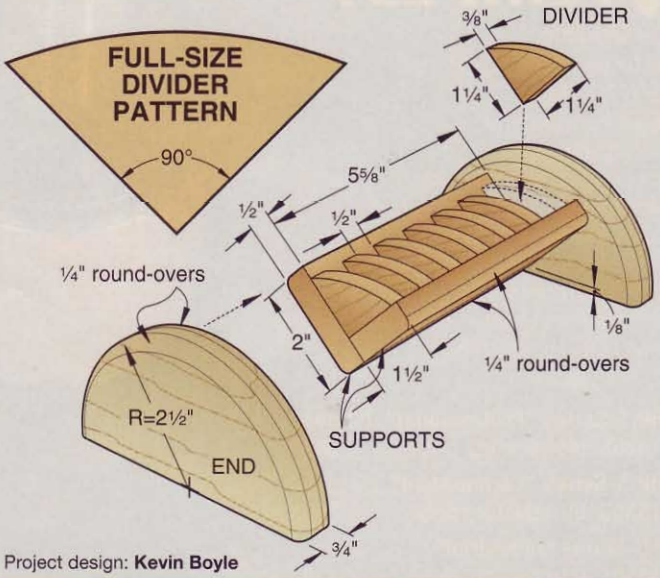
CD/DVD holder

Minimize on wood, not functionality, with this impressive and expandable project.

Organize and display your CDs or DVDs with this quick-and-easy storage specialist. It's so simple, you may as well build several at the same time; they make excellent gifts. As is, the holder accommodates six CDs; but for more capacity, simply extend it 7/8" for each additional piece of media. We used cherry for the supports and dividers, and quilted-maple scraps for the ends, but any wood will do.

To build one, cut the ends, supports, and dividers to the sizes and shapes shown *below*. Use the full-size pattern to cut the dividers. Rout 1/4" round-overs where indicated, and finish-sand all the parts. Glue the two supports together and add the ends. Then, using 1/2"-thick spacers, glue the dividers in place. Stain, if desired, and add a clear finish.



Project design: **Kevin Boyle**

Pick the best TAPE for every job

Choosing the right tape is as important as choosing the right tool. Here are some of our favorites.

Contrary to workshop lore, duct tape won't solve every problem any more than 4" lag screws meet all your fastener needs. In the *WOOD*® magazine workshop, we have a whole drawer full of sticky solutions to sticky problems.

Heavy-duty duct tape

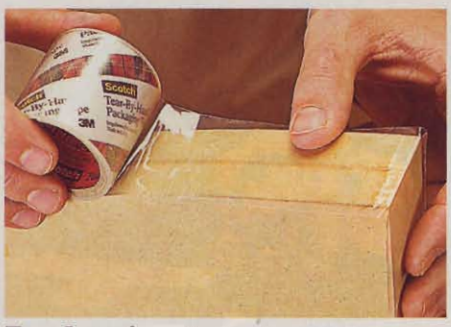
When standard duct tape won't hold, use its big brother. Heavier fabric and twice the adhesive create a firm grip on rough surfaces.
Use it to: reinforce dinged (but not cracked or broken) tool handles and hold together metal pipe sections and fittings for a dust-collection system.

Painter's tape

Sure, it costs more than the beige masking tape, but it also deposits less adhesive residue and won't pull up loose wood fibers.
Use it to: keep stain or finish off areas to be glued, pull together small glue-up parts, label project parts, and protect bar clamps or wood surfaces from glue squeeze-out.

Double-faced tape

This fabric-backed version sticks better, but peels off more easily than the plastic type.
Use it to: temporarily attach an auxiliary tablesaw fence, attach thin stock to MDF for planing, temporarily mount drawer faces while positioning them within an opening, and mount blanks on faceplates for turning.

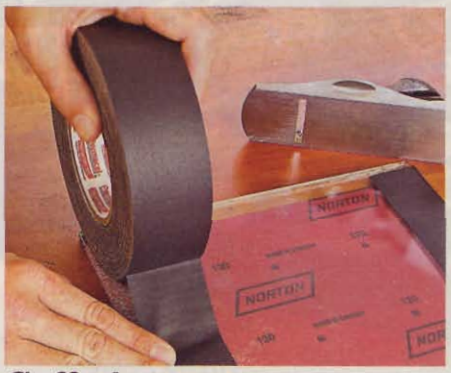


Packaging tape

Think of this as Teflon on a roll when it comes to glue-ups.
Use it to: glue-proof bent lamination forms, protect corner angle braces from glue drips, and add durable but replaceable protection to clamps. Still another use: waterproofing paper labels on bottles of liquids.

Linen tape

This tape helps prevent dried-out adhesive from yellowing and damaging framed photographs and artwork. The tape is acid-free, and the acrylic adhesive won't break down or yellow with age.
Use it to: attach artwork and hinged mat windows on mounting boards.



Gaffer's tape

A common sight in photo studios, this fabric tape has the adhesion and durability of duct tape without the messy adhesive residue.
Use it to: attach abrasive sheets to glass to flatten plane soles and waterstones or to make temporary tool repairs.

Low-friction tape

Avoid wood-on-wood friction with ultra-high molecular weight (UHMW) tape.
Use it to: help drawers slide smoothly, add friction-free surfaces to jigs and fences, and provide glides on the bottom edges of projects you'll need to slide for easy moving.

Veneer tape

Unlike masking tape, veneer tape comes perforated or thin enough to view seams. Its special paper can be sanded or scraped away with little adhesive residue left behind.
Use it to: temporarily hold veneer pieces in place without shifting.

Stretchable tape

Scotch Stretchy Tape holds like packaging tape but with more stretch.

Use it to: pull together a small glue-up, such as a mitered jewelry box, without clamps, and to repair cracks in corrugated shop-vacuum hoses.

Top off your tape drawer with these:

✔ ***Electrical tape.*** Good for bundling wires, reinforcing twist-on wiring connectors, and wrapping around electrical cords where there's evidence of abrasion.

✔ ***Grip tape.*** Wrapped around tool handles, this tape creates a non-slip gripping surface. Look for it in sporting goods stores where it's sold to wrap baseball and softball bat handles.

✔ ***Binding tape.*** Use this "flat twine" to bundle material for storage. You can find this at many office supply stores.

✔ ***High-friction tape.*** Keeps objects in place, but allows them to be repositioned. For example, use it on the clamp face and fence of a mortiser to hold parts firmly in place while you work.

Sources

Double-faced tape: 108' rolls at 1" wide (no. 15D25, $16.99) or 2" wide (no. 15D26, $34.99). Woodcraft. Call 800/225-1153, or visit woodcraft.com.

Gaffer's tape: Permacel 665, 2"x180', $12.59. Harrison Brothers. Call 866/386-8335, or visit thetapeworks.com

Heavy-duty duct tape: Gorilla Tape, 1.88"x105', $10. Gorilla Glue Co. Call 800/966-3458, or visit gorillatape.com.

High-friction tape: 1"x18', no. 25U04.01, $9.50. Lee Valley Tools. Call 800/871-8158, or go to leevalley.com.

Linen tape: 1¼x400", no. 99K34.10, $12.95. Lee Valley Tools.

Low-friction tape: ¾"x6', no. 086091, $5.99; 2"x6', no. 086092, $11.99; 3"x6', no. 086093, $14.99. Highland Hardware. Call 800/241-6748, or visit tools-for-woodworking.com.

Stretchable tape: Scotch Stretchy Tape, 1.88"x30' without dispenser, $2.50, to 1.88"x90' with dispenser, $5.99. 3M. Go to ScotchBrand.com.

Veneer tape: ¾"x650', no. 27K07.65, $4.95. Lee Valley Tools. Two-hole perforated tape, ¾"x650', no. SV20005, for $6.95). Klingspor's Woodworking Shop. Call 800/228-0000, or visit woodworkingshop.com.

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Circle No. 2039

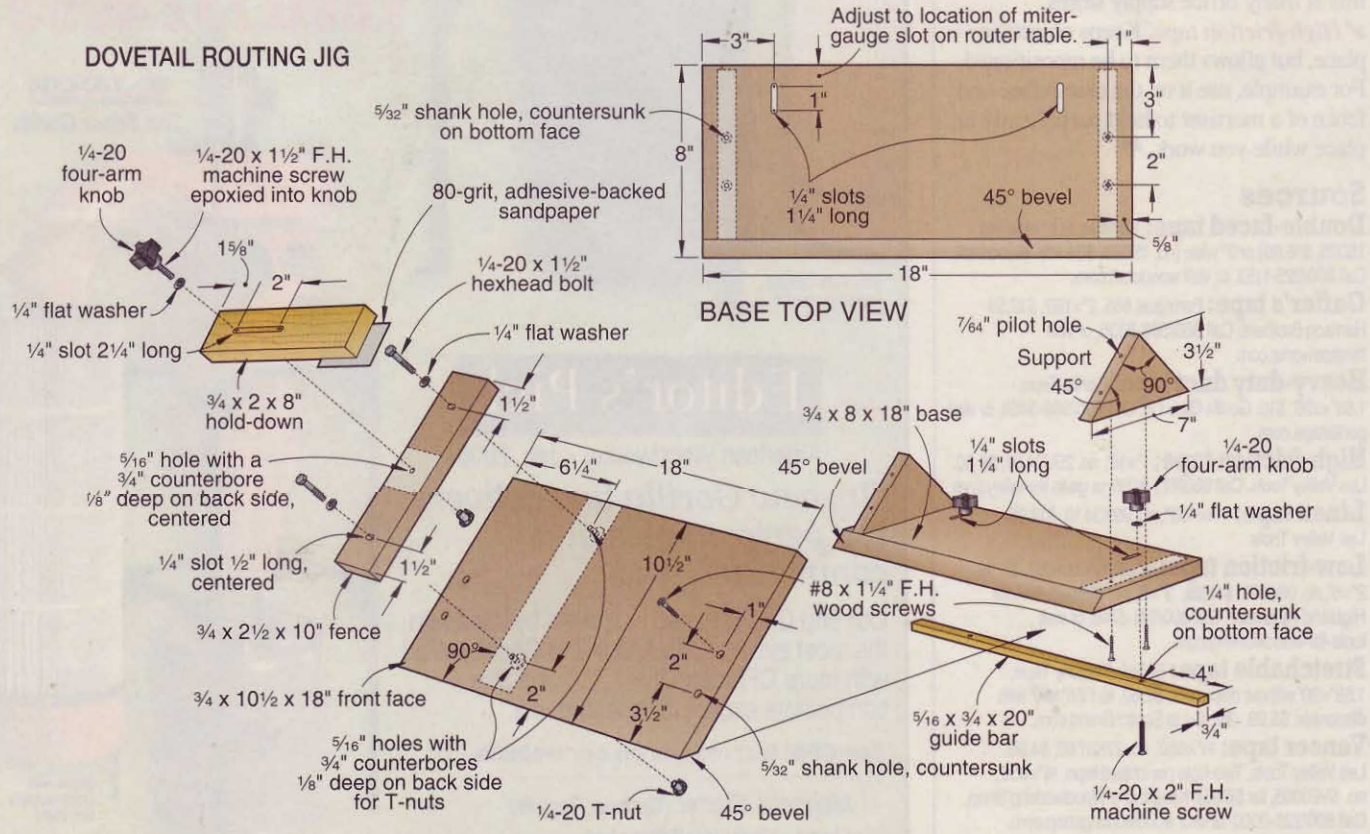
butterfly spline joints

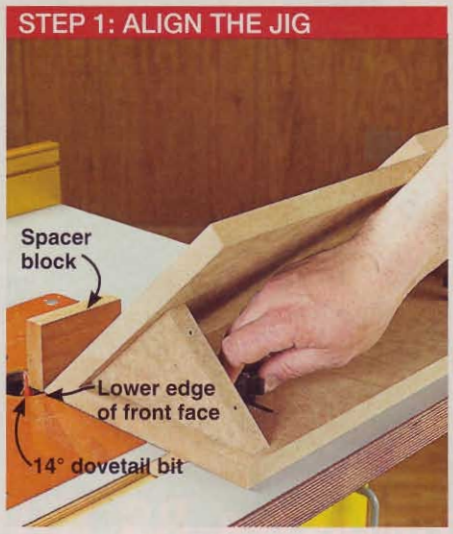
Not just for looks, the signature key stock shown in the frame *above* gives miters added strength.

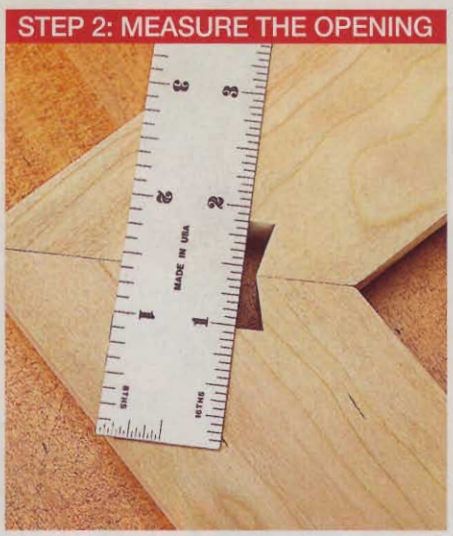
Butterfly spline-reinforced mitered corners will test your skill and patience. But they'll also reward your care and perseverance with a decorative joint that strengthens any miter from a simple picture frame to a cabinet face frame.

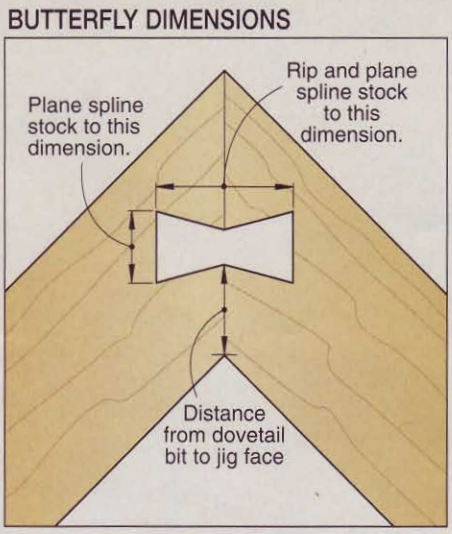
Start by building the dovetail cutting jig shown *below*, a modified version of one used by Massachusetts box maker Al Ladd to make reinforced box corners. Then we'll create a joint where the butterfly spline passes through the thickness of the stock. As your skills increase, try cutting dovetails

continued on page 34








BUTTERFLY DIMENSIONS
Plane spline stock to this dimension.
Rip and plane spline stock to this dimension.
Distance from dovetail bit to jig face

for box corner splines that pass the length of the miter, as shown on *page 37*.

To increase your success rate, use new or freshly sharpened bits for cutting both dovetails and splines. (See "Butterfly spline bit sources" on *page 37*.) Butterfly spline bits cut splines in two passes instead of the four you would need using a 14° dovetail bit.

To begin, cut four 45° mitered pieces of identical thickness and width for practicing the technique. Make pieces on opposite sides of the frame the same length.

Before you begin, check that the jig fence runs parallel to the miter-gauge slot. Now, let's work through the following steps:

Install a 14° dovetail router bit and set the bit height to half the desired length of your butterfly spline. Then measure how far you want the inside edge of the dovetail slot from the inside corner of the miter joint, as illustrated *above right*. Cut a spacer block equal to that distance in its thickness.

Use this spacer to position the jig's front face a uniform distance from the dovetail bit as the jig rides along the router table's miter-gauge slot. Place the spacer against the bit and move the lower edge of the front face of the jig until one corner rests firmly against the spacer, as shown in **Step 1**. Lightly tighten the adjustment knob at that end. Do the same thing at the opposite end of the jig, again lightly tightening the adjustment knob. Double-check the spacings on both ends of the jig until they're the same, then firmly tighten both adjustment knobs. This ensures your dovetail bit will pass straight through the mitered edge instead of cutting at a slight diagonal.

We designed this jig with a hold-down for securing ¾" stock, giving it the potential to make edge-to-edge dovetails along miters. To make cuts like the ones shown at *top right* on *page 32*, however, remove the hold-down and clamp the frame piece and a backer board to the edge of the fence. With the miter flat against the router table, cut the dovetail opening. Repeat on the other end and on the ends of the remaining pieces.

Measure the length of the opening created by the mating dovetails, as shown in **Step 2**. Then measure the width of the opening at its narrowest and widest points.

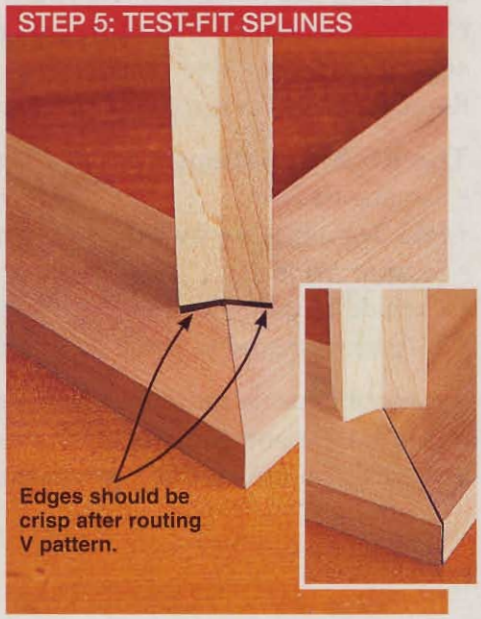
Next, plane your spline stock to slightly thicker than the widest end of your dovetail slots, as illustrated *above*.

Set your tablesaw fence-to-blade distance 1/64" greater than the length of the butterfly opening and cut several spline blanks, as shown in **Step 3**.

Install a butterfly spline bit (or a dovetail bit for making four instead of two cuts), and make partial test cuts in a blank, as shown in **Step 4**, and raise or lower the bit until the V pattern is centered in the stock on both sides.

Once the bit is centered, make a test key to check its dimensions against the butterfly opening, as shown in **Step 5**. A key that's too long will push the mitered edges apart, as shown in **Step 5, Inset photo**.

continued on page 37



STEP 6: FINE-TUNE THE SPLINES

If the spline is too long, sand equal amounts from both sides using adhesive-backed 150-grit sandpaper on a flat surface, as shown in **Step 6**. Custom fit keys to each corner and cut them about 1" thicker than needed. Mark which spline goes in each corner and its orientation.

Glue and clamp the mitered edges together, aligning the dovetails at each corner to accept their splines. Avoid applying glue to the insides of the dovetail slots until you're ready to insert the splines.

STEP 7: FLUSH-CUT THE SPLINES

Then apply glue to the sides of the butterfly splines and insert them through the openings. Once the glue dries, flush-cut the splines to the frame surface, as shown in **Step 7**, and sand flush.

For a challenging variation on this joinery technique, try making reinforced box corners with splines running the length of the miter, as shown *above right*. The splines and dovetails are longer, but you'll use the same skills needed to make the butterfly spline frame corners.

BOX-CORNER SPLINES

Butterfly spline bit sources

Amana: No. 45860 with a 1¾" cutting length (estimated cost, $67; price varies with dealer). Call 800/445-0077, ext. 500, or click amanatool.com for information and suppliers.
Eagle America: No. 191-1205 with a 1⅛" cutting length ($30) and no. 191-2005 with a 2" cutting length ($40); 800/872-2511 or eagle-america.com.
Freud: No. 24-106 with a 1¾" cutting length (around $60; price varies with dealer), 800/334-4107 or freudtools.com.

Jig design: **Al Ladd** with ***WOOD*** **magazine**

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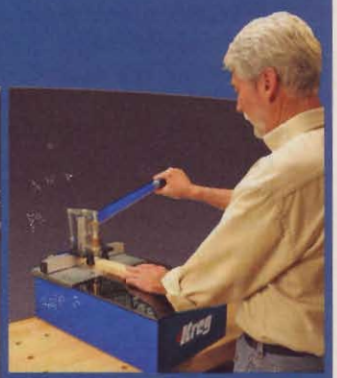

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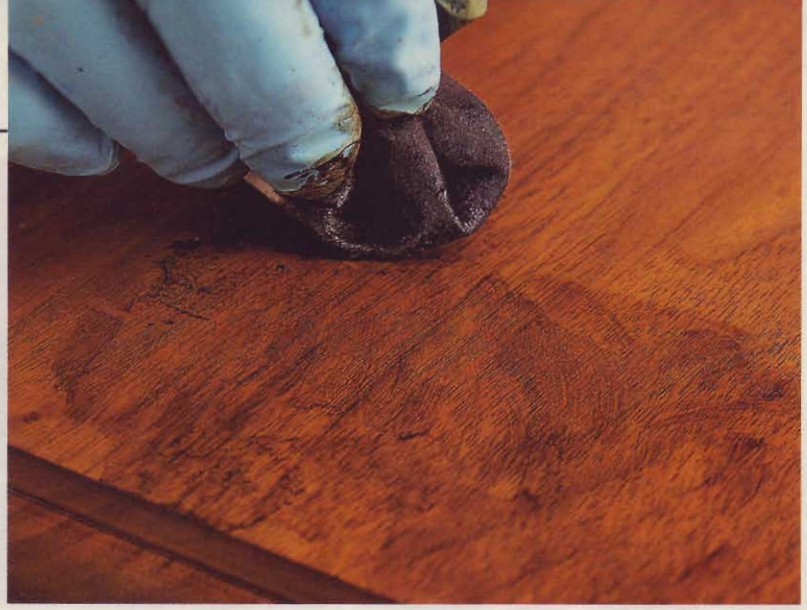
protect wood with paste wax

This time-tested product protects finished projects against wear and adds shine. In some cases, it can even serve as the finish itself, applied directly onto bare wood.



After you complete a woodworking project and apply the finish, consider adding a coat of paste wax for protection and good looks. Or when you fashion a decorative piece that won't be handled much—a turned vessel or a picture frame, for example—wax on bare wood offers a nice, natural look.

Most paste waxes contain the following:

- Solvent (toluene or a turpentine substitute, typically) that emulsifies the wax to ease application.
- Soft wax (such as beeswax or paraffin) that makes buffing easier.
- Hard carnauba wax that produces a clear, glossy shine.

To use paste wax, allow the finish to cure for several days and then apply wax, as shown *above* and at *right*. Ensure adequate ventilation and wear gloves to prevent skin contact with the solvent. Keep the coating very thin; one tablespoon is enough to cover a large dining table. For textured surfaces, buff the wax with a shoe brush.

Or, if you like, use tinted paste wax to color and finish bare wood, as shown *right*, or change the tone of finished wood, as shown *far right*. Use a matching color to hide scratches and cracks in an old finish.

The lifespan of a wax coating depends on how you use the piece. A coffee table in a busy family room, for instance, receives more wear than an accent table off in a corner. Rejuvenate a dull surface by buffing. When this no longer creates a shine, apply more paste wax. The new wax dissolves the existing layer and you buff away the excess, preventing build-up.

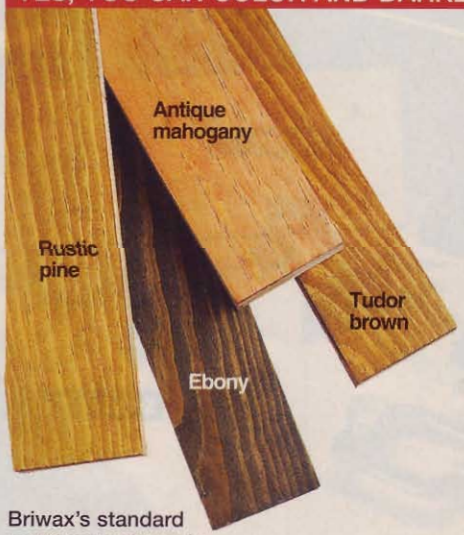
If you ever need to repair the finish, remove the wax so it doesn't interfere with the bonding of new finish. Simply moisten a cloth with mineral spirits (paint thinner) and thoroughly wipe the surface.

APPLY WAX FOR A RICH SHINE

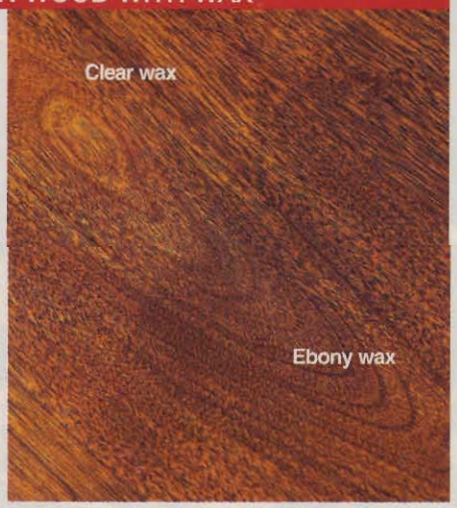
Place a chunk of wax on a cotton cloth, fold the corners together, twist the top, and you have an applicator that oozes wax. Rub it gently in a circular motion across the surface as shown at top of page.

When the wax coat turns dull, buff it with a pad installed in a portable drill. Woodworker's Supply (800/645-9292) carries a wool pad (item 958-735) for $10.99 and a backing disc (958-728) for $21.49.

YES, YOU CAN COLOR AND DARKEN WOOD WITH WAX



Briwax's standard paste wax comes in seven colors, including the four you see on these pine samples.



Two types of wax create two very different looks on this clear-finished walnut tabletop. Notice that tinted wax emphasizes the contrasts in the grain pattern.

COVER PROJECT

comfy classic garden bench

Build the best seat outside the house with this handsome project.

Solid cedar, mortise-and-tenon joinery, waterproof glue, and stainless-steel fasteners mean this traditionally styled bench will look good for years. To make a matching chair or settee by simply changing the length of a few parts, see the drawings and instructions on *page 93*.

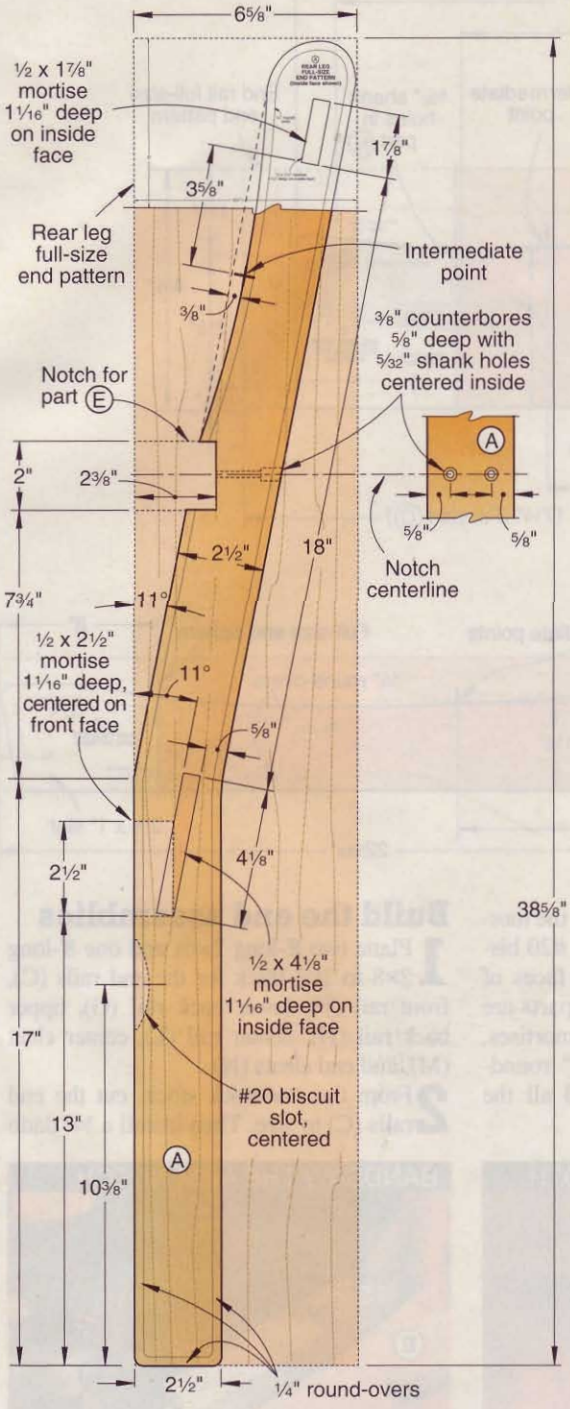
Start with the legs

Note: *Due to the high moisture content of construction-grade lumber, the cedar used for this project can shrink significantly after you purchase it. To minimize shrinkage problems, stack and sticker your boards indoors and off the floor for at least one week. When selecting glue, turn the higher moisture content of the lumber to your advantage by using polyurethane glue, which requires moisture to cure.*

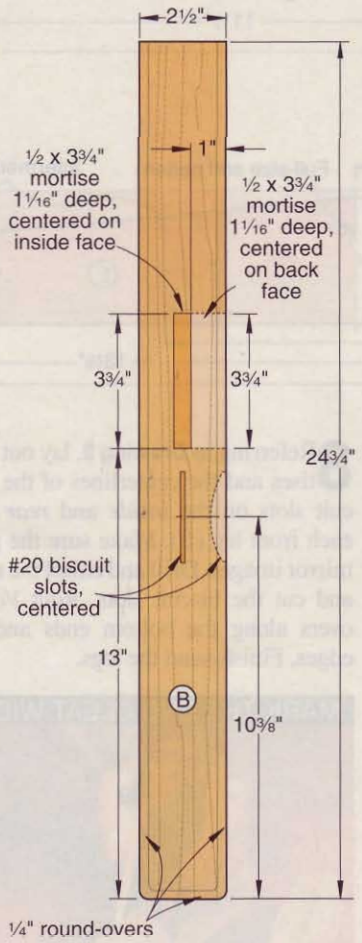
1 For the rear legs (A), front legs (B), and arms (E), laminate oversize blanks from two pieces of 1½"-thick stock. (We used polyurethane glue.) Plane the resulting 3"-thick blanks to 2½" thick, removing equal amounts from each face. Then joint one edge. Rip and crosscut the blanks to the sizes listed on the **Materials List**.

2 Referring to **Drawing 1**, lay out the shape of the rear legs (A) on the *inside* faces, including the dashed line at the upper front face of the leg. (When first bandsawing the leg to shape, you'll cut along the straight dashed line.) Then lay out the notch for the

1 REAR LEG (Inside face shown)



2 FRONT LEG (Inside face shown)



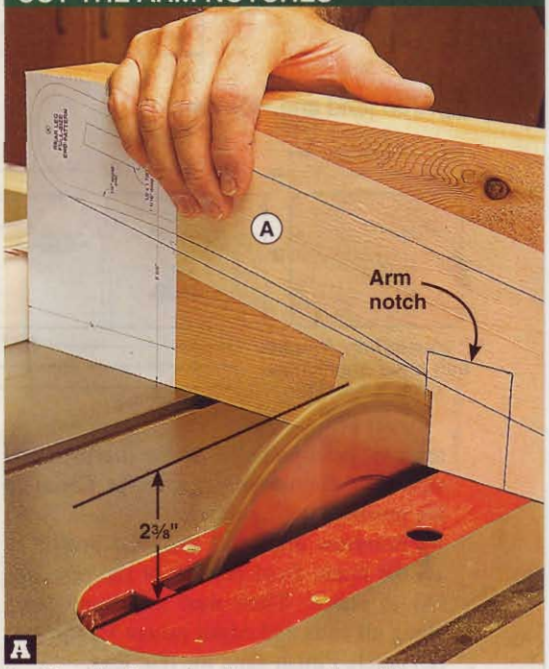
SHOP TIP

Masking tape adds clarity to part layout

More than half the parts in this project require laying out the shape of the part and the location of mortises, biscuit slots, and notches. When drawing on softwood, such as cedar, or coarse-grained wood, such as oak, your pencil may wander off course as it follows the grain. And, the poor contrast of pencil lines on dark woods makes following layout lines difficult when bandsawing and sanding. Finally, after you finish shaping the part, you'll have to sand away all remaining lines. Here's an easy solution.

Before drawing any lines, adhere 2"-wide masking tape to the stock approximately where the layout lines will be. Then draw the lines on the tape with a pencil. Correct mistakes by taping over them and redrawing. To avoid cutting errors and to increase visibility, go over your final layout lines with an ultra-fine-point marker. After shaping the part, remove the masking tape.

CUT THE ARM NOTCHES



Position the fence to align one edge of the arm notch with the blade, and make a cut. Reposition the fence, and cut the other edge.

arm (E), the lower mortise on the inside face, the mortise on the front face, and the centerline of the #20 biscuit slot. Make sure the legs are mirror images. Now make a photocopy of the **Rear Leg End Patterns** on the *WOOD Patterns®* insert and adhere them to the blanks with spray adhesive.

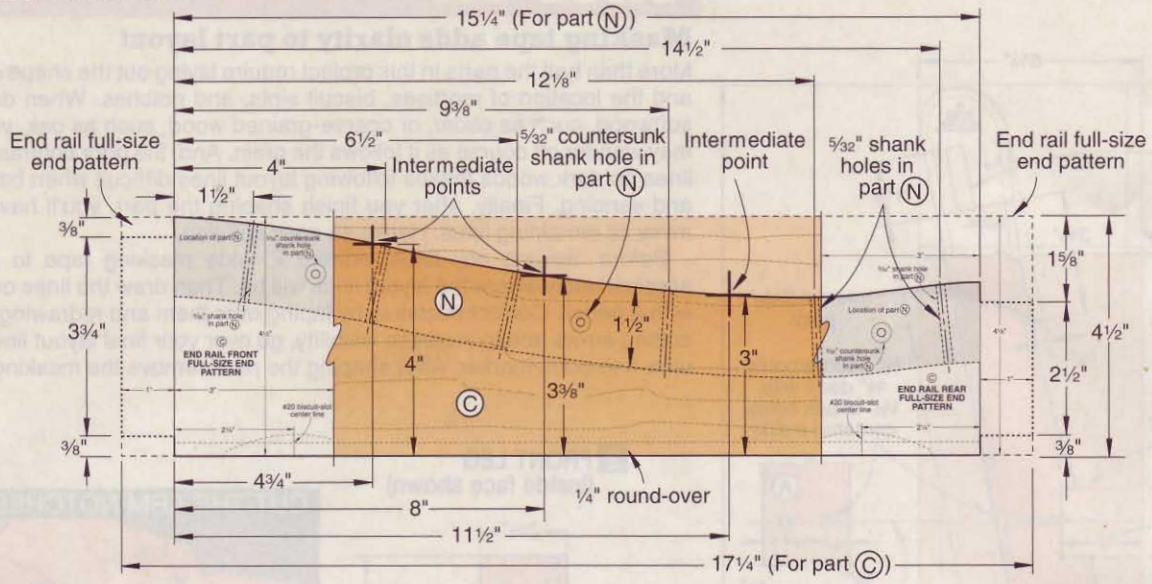
3 To stabilize the rear leg (A) blanks when cutting the arm (E) notches, attach a 6"-tall extension to your tablesaw miter gauge. Raise the blade to 2⅜". Then place one blank on edge against the miter gauge, and using the fence as a stop, define both edges of the notch with saw kerfs, as shown in **Photo A**. Now make multiple passes between the two kerfs to clean out the notch. Move the fence and miter gauge to the other side of the blade and repeat with the other leg blank.

4 To form the ½x2½" mortise 1 1/16" deep in the front edge of each rear leg (A), chuck a ½" brad-point bit in your drill press and position the fence to center the bit on the mortise marked on each blank. Then drill overlapping holes 1 1/16" deep. Smooth the sides of the mortise and square the ends with a chisel. Now cut a slot for a #20 biscuit, centered in the front face of each leg, where shown on **Drawing 1**.

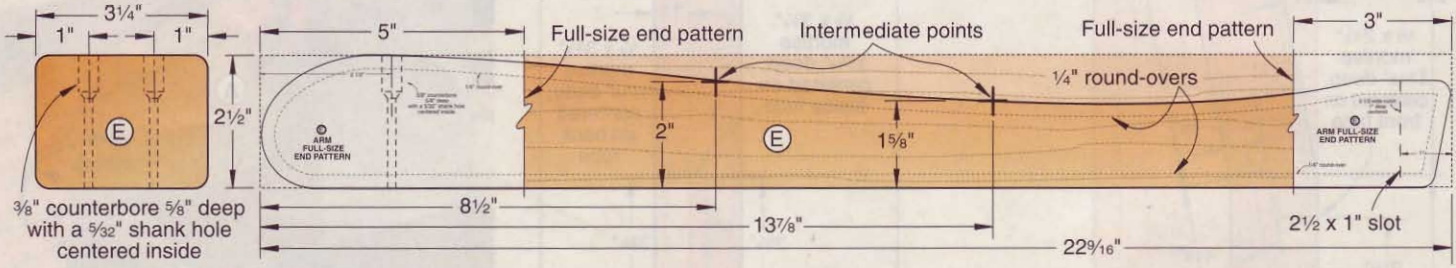
5 Bandsaw and sand each rear leg (A) *back* profile to shape. Then placing each leg blank on the front edge, use your drill press to drill ⅜" counterbores ⅝" deep with 5/32" centered holes, centered vertically in the arm (E) notch, where shown on **Drawing 1**.

6 Bandsaw and sand each rear leg (A) *front* profile to shape, following the straight dashed line between the notch for the arm (E) and the top of the leg. Then, placing the front edge of the angled portion of the leg against the drill-press fence, cen-

3 END RAIL AND END CLEAT



4 ARM (End and side view)



ter a ½" brad-point bit on the mortises and drill 1⁹⁄₁₆"-deep overlapping holes. Clean up the mortises with a chisel.

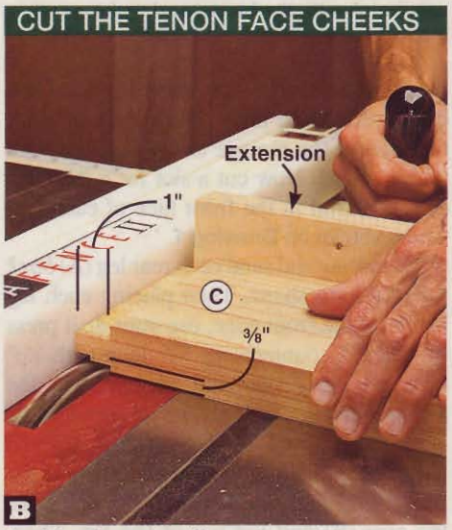
7 Bandsaw and sand the final profile of the upper front portion of the rear legs (A) to shape. Then rout ¼" round-overs along all ends and edges *except* for the arm (E) notch. Finish-sand the rear legs.

8 Referring to **Drawing 2**, lay out the mortises and the centerlines of the #20 biscuit slots on the *inside* and *rear* faces of each front leg (B). Make sure the parts are mirror images. Drill and chisel the mortises, and cut the biscuit slots. Rout ¼" round-overs along the bottom ends and all the edges. Finish-sand the legs.

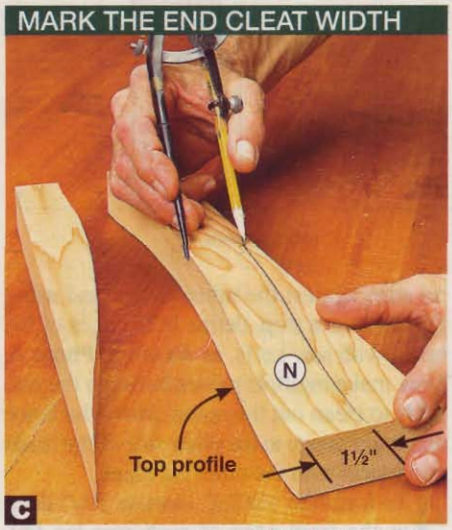
Build the end assemblies

1 Plane two 8'-long 2×6s and one 8'-long 2×8 to 1¼" thick for the end rails (C), front rail (F), lower back rail (G), upper back rail (H), center rail (L), center cleat (M), and end cleats (N).

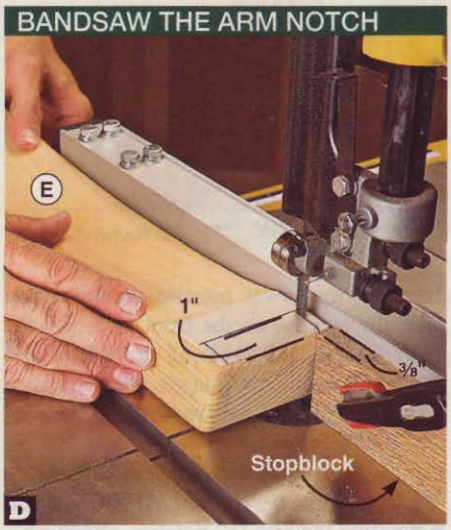
2 From the 1¼"-thick stock, cut the end rails (C) to size. Then install a ¾" dado



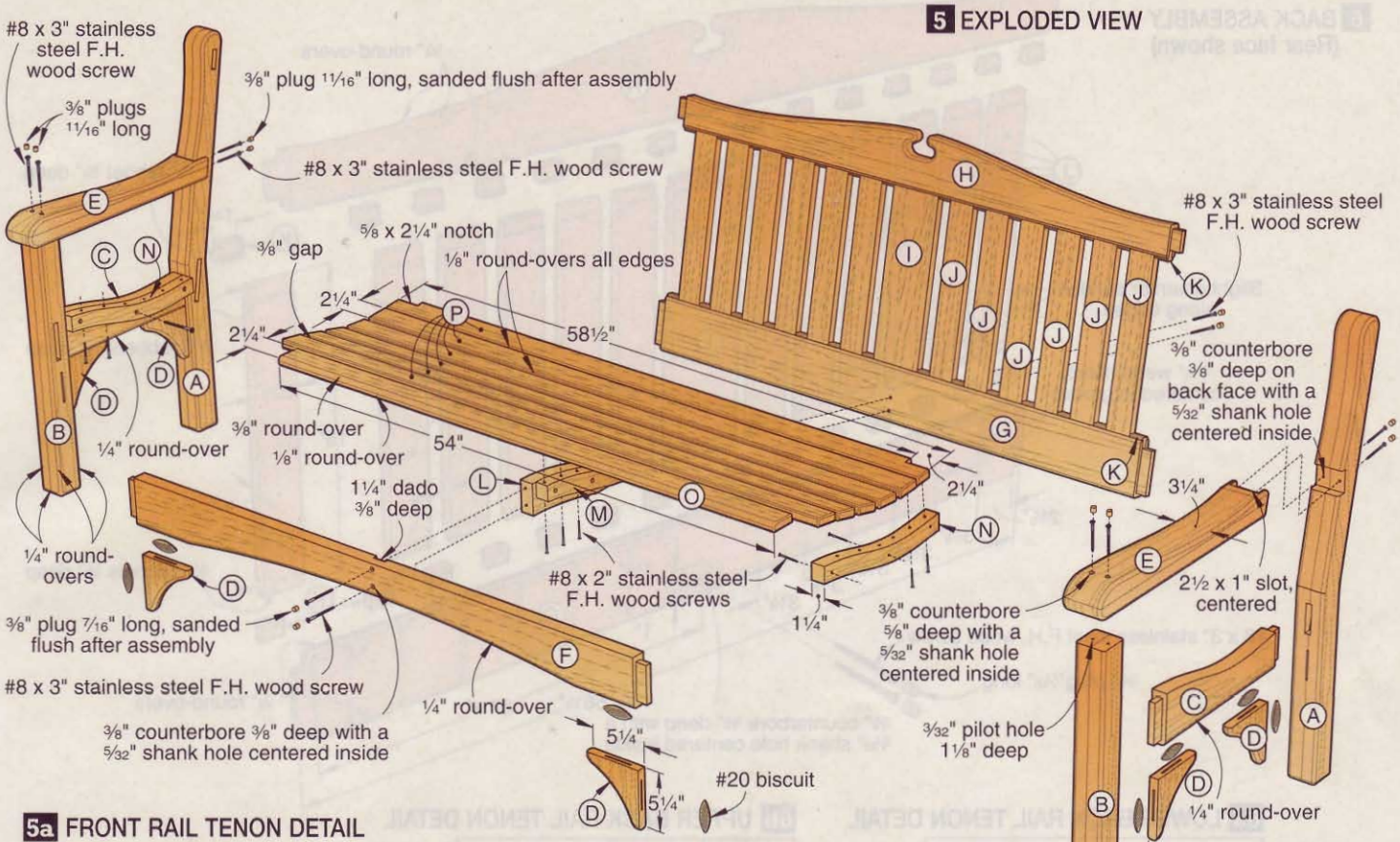
Backing the cuts with a miter-gauge extension, position the fence as a stop, and cut 1"-long tenons on each face.

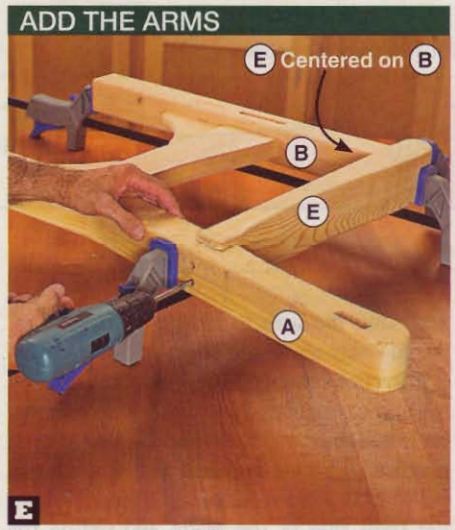


With your compass opened to 1½", follow the top profile of the end cleat (N) with the compass point and draw the cleat width.



With the bandsaw rip fence ⅜" from the left side of the blade and a stopblock 1" from the front of the blade, cut one side of the notch.





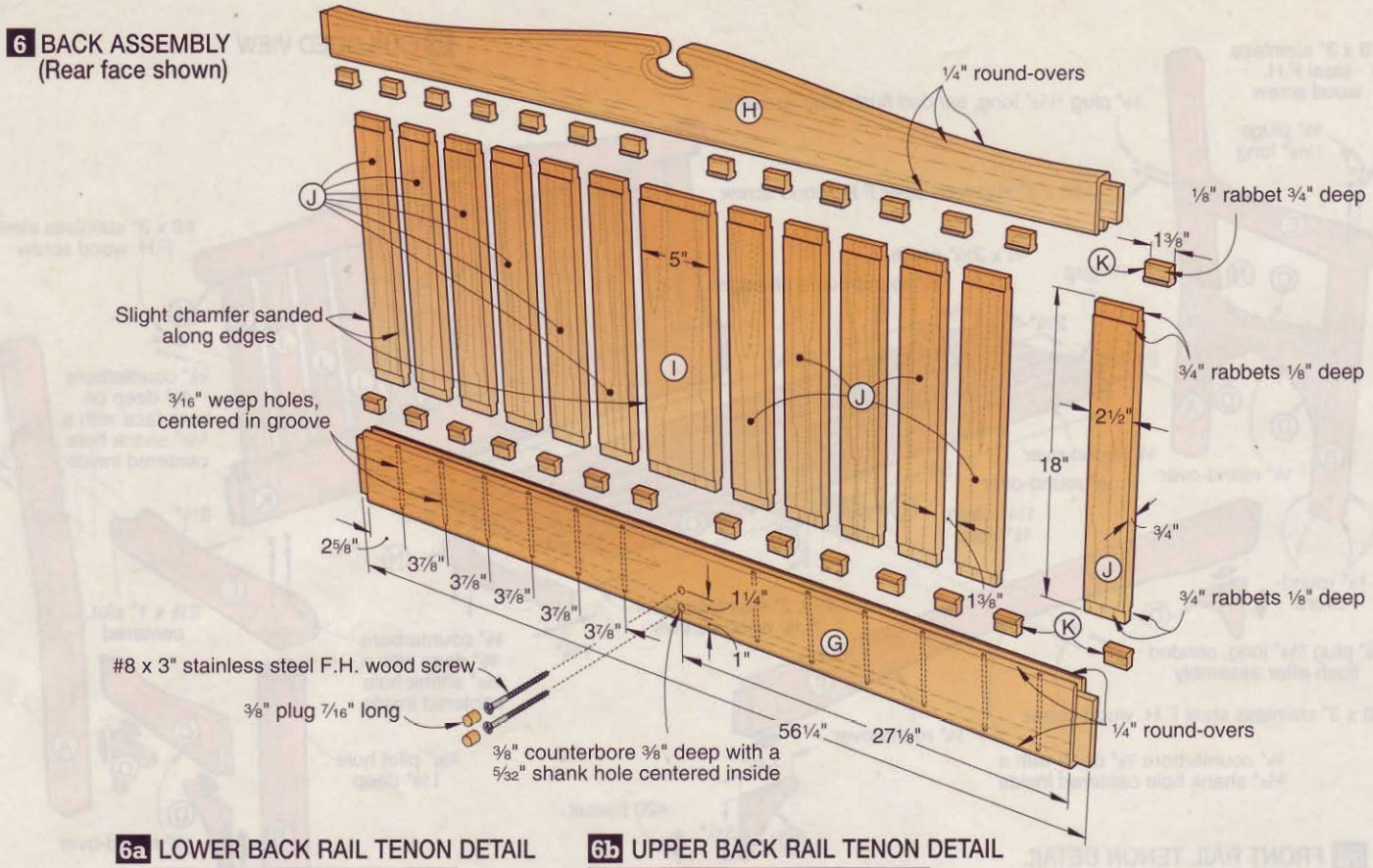
Glue and clamp the arms in place. Then using the holes in the rear legs as guides, drill pilot holes into the arms, and drive the screws.

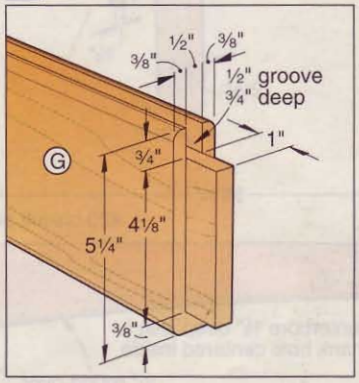
blade in your tablesaw, and adjust it to cut ⅜" deep. With the rails flat on the saw table, cut 1"-long tenon face cheeks on both ends of the rails, where shown on **Drawing 3** and as shown in **Photo B**. Now position each rail on edge, and cut the front tenon upper and lower cheeks and the rear tenon lower cheek. Next, measuring from the bottom of the tenon, mark the 2½" rear tenon width and form the top rear tenon cheeks with your bandsaw.

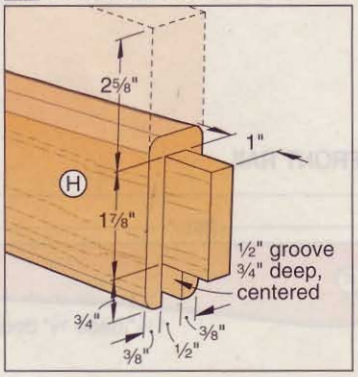
3 Make a photocopy of the **End Rail End Patterns** on the insert and adhere them to one end rail (C) with spray adhesive, where shown on **Drawing 3**. Then lay out the three intermediate points of the top profile where dimensioned, and connect the end patterns with a smooth line connecting the points. Bandsaw and sand the rail to shape. Now cut slots for #20 biscuits centered in the bottom edge of the rail, where dimensioned on the patterns. Next, using the completed end rail as a template, trace the profile onto the other end rail, and bandsaw and sand it to shape. Lay out the biscuit centerlines, and cut the slots. Chuck a ¼" round-over bit into your table-mounted router and rout the bottom edges of the rails.

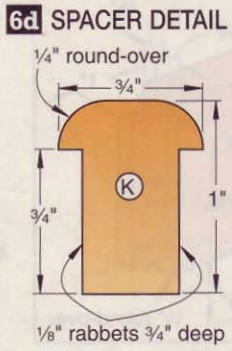
4 From the 1¼" stock, cut the end cleats (N) to size. Again using the end rail (C) as a template, trace the top profile onto the cleats, where shown on **Drawing 3**. Then bandsaw and sand the top profile to shape. Now draw the 1½" cleat width, as shown in **Photo C**, and bandsaw and sand them to shape. Set the cleats aside.

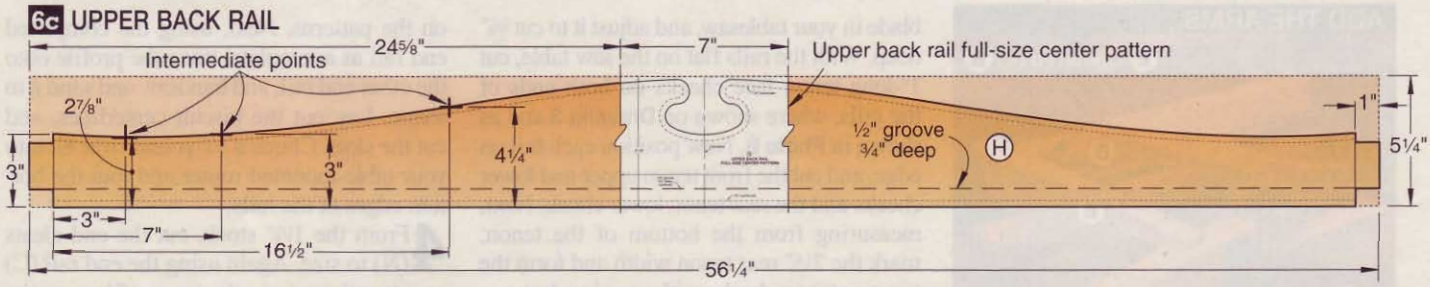
5 Cut six blanks for the brackets (D) to the size listed. Make a copy of the **Bracket Pattern** on the insert, and adhere it to one blank. Cut centered slots for #20 biscuits in all six blanks, where dimensioned on the











pattern. Then bandsaw and sand the bracket to shape. Using this bracket as a template, trace the shape onto the remaining bracket blanks and bandsaw and sand them to shape. Now use your table-mounted router to rout ¼" round-overs along the edges of all the brackets, where shown on the pattern.

6 Retrieve the laminated blanks for the arms (E). Make a copy of the **Arm End Patterns** on the insert and adhere them to one blank, where shown on **Drawing 4**. Drill two ⅜" counterbores ⅝" deep with 5/32" shank holes centered inside, where dimensioned. Then lay out the two intermediate points of the top profile, where dimensioned. Now complete the pattern by drawing a smooth line through the intermediate points. Bandsaw and sand the arm to shape. Using this arm as a template, trace the outline onto the other blank. Drill the holes and bandsaw and sand the arm to shape. Next rout ¼" round-overs along the edges of both arms.

7 To cut a centered 2½"-wide notch 1" deep at the rear of each arm (E), where shown on **Drawings 4** and **5**, define one side of each notch with a 1"-long bandsaw cut, as shown in **Photo D**. Then reposition the fence 3" from the right side of the blade and define the other side of the notch with another cut. Now saw out the material between the side cuts.

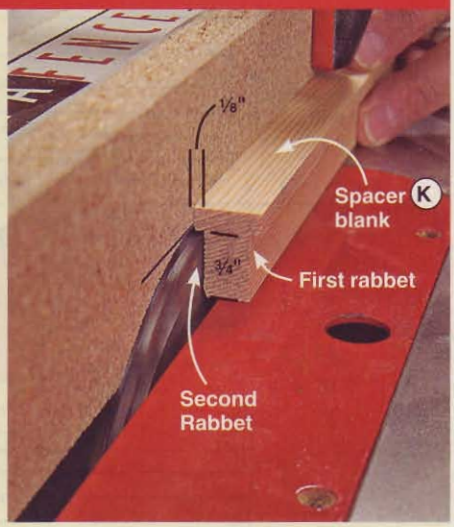
SHOP TIP

House your dado blade to cut clean rabbets

To cut rabbets, like those along the edges of the spacer (K) blank, you can install a dado blade the exact width of the rabbet in your tablesaw, and adjust the height. Then clamp an auxiliary fence to the rip fence, and position it so the blade just grazes the surface, and cut the rabbet. But this method may require shimming the dado blade to obtain the exact width rabbet, and the minute gap between the blade and the auxiliary fence leaves a ragged "splinter" along the edge. **Here's a better way.**

Install a dado blade ⅛" wider than the needed rabbet, and position it just below the table surface. Then attach a wood auxiliary fence to the rip fence. (Use ¾"-thick stock for dado blades up to ½" wide and 1½"-thick stock for blades over ½".) Make a mark on the auxiliary fence 1/16" higher than the depth of the rabbet. (The extra 1/16" keeps the blade from dragging on the auxiliary fence during final adjustment.) Position the rip fence so the

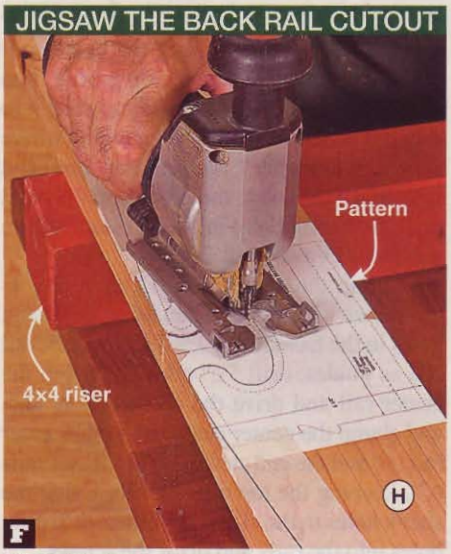
auxiliary fence covers all but about 1/16" of the blade, and lock the fence in place. Now turn on the saw and slowly raise it to the marked line, as shown *above*. (The extra-width cut in the auxiliary fence provides for plenty of side-to-side adjustment.) Turn off



the saw, and adjust the blade and fence to cut a rabbet to the desired depth and width. The housed blade eliminates the splinter-producing gap. Turn on the saw, and cut the rabbets in the workpiece, as shown *above*.

8 Spread glue in each rear leg (A) front mortise and in each front leg (B) back mortise. Insert the end rail (C) tenons, where shown on **Drawing 5**, and clamp the assemblies. Then glue and biscuit four of the brackets (D) in place, clamping them tight into the corners to square the assemblies.

9 Glue and clamp the arms (E) in place, interlocking the notches with the rear leg (A) notches, and centering the arms over the front legs (B). Fasten the arms to the rear legs, as shown in **Photo E**. Then using the holes in the arms as guides, drill pilot holes into the front legs and drive the screws.



Place the upper back rail (H) on a pair of 4x4 risers for blade clearance and use your jigsaw to remove the center cutout.

Make rails for the back

1 From the 1¼"-thick stock, cut the front rail (F), lower back rail (G), and upper back rail (H) to size. Then, as when forming the tenons on the end rails (C) shown in **Photo B**, install a ¾" dado blade in your tablesaw, adjust it to cut ⅜" deep, position the fence as a stop, and cut 1"-long tenon face cheeks on the part ends, where shown and dimensioned on **Drawings 5**, **5a**, **6**, **6a**, and **6b**. Now stand the rails on edge and cut the front rail upper and lower tenon cheeks and the lower back rail lower tenon cheeks. Next cut a centered 1¼" dado in the rear face of the front rail for the center seat rail (L).

2 Install a ½" dado blade in your tablesaw and adjust it to cut ¾" deep. Then cut centered grooves in the top edge of the lower back rail (G) and the bottom edge of the upper back rail (H), where dimensioned on **Drawings 6a** and **6b**. Now mark the 1⅞" upper back rail tenon width, and form the top tenon cheeks with your bandsaw.

3 Drill ⅜" counterbores with centered 5/32" shank holes in the front rail (F) and lower back rail (G), where shown on **Drawings 5b** and **6**. Cut slots for #20 biscuits in the front rail, where dimensioned. Using a fairing stick, draw the arch at the bottom of the front rail. Bandsaw and sand it to shape.

4 Chuck a 3/16" drill bit 6" long into your drill press and drill centered weep holes in the lower back rail (G), where shown on **Drawing 6**. Drill as deep into the rail as the throw of the drill press allows, and finish the holes with a handheld drill.

5 Make a photocopy of the **Upper Back Rail Center Pattern** on the insert and adhere it to the upper back rail (H), where shown on **Drawing 6c**. Then to the left and right of the center pattern, lay out three intermediate points of the top curve, where dimensioned, and complete the pattern with smooth lines through the points. Remove the center cutout, as shown in **Photo F**. Now bandsaw the remaining profiles, and sand them and the center cutout to shape.

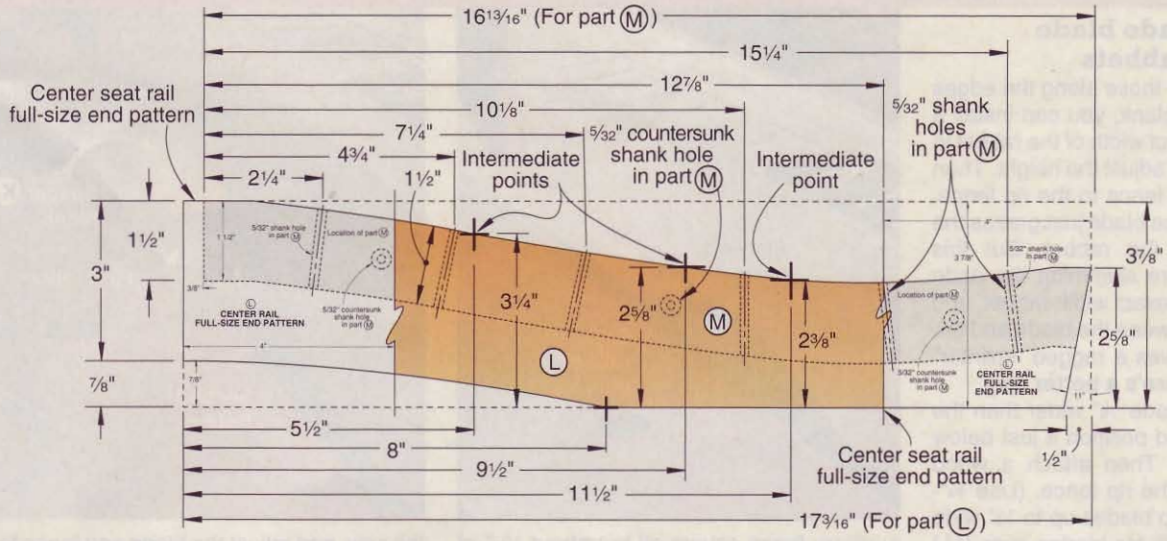
6 Chuck a ¼" round-over bit into your handheld router and rout the front rail (F) bottom front edge and all edges of the lower back rail (G) and upper back rail (H). Finish-sand the parts.

Now assemble the back

1 From ¾"-thick stock, cut the center back slat (I) and back slats (J) to size. Install a ¾" dado blade in your tablesaw, and adjust it to cut ⅛" deep. Then cut ¾"-long tenons on the ends of the slats, where shown on **Drawing 6**. Now finish-sand the slats and sand slight chamfers along all the edges with a sanding block.

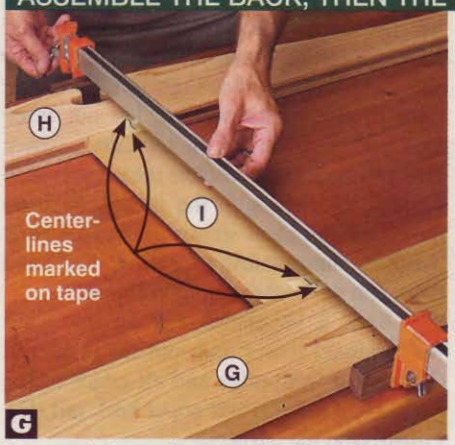
2 Cut a ¾x1x48" blank for the spacers (K). Then cut ⅛" rabbets ¾" deep along the bottom edges, where shown on **Drawing 6d**. To accomplish this task, see the **Shop Tip** *above*. Chuck a ¼" round-over bit into your table-mounted router, position the fence flush with the pilot bearing, and rout the top edges of the blank. Now cut 24 spacers to length. (You'll measure and cut the remaining four to length during assembly.)

7 CENTER RAIL AND CENTER CLEAT



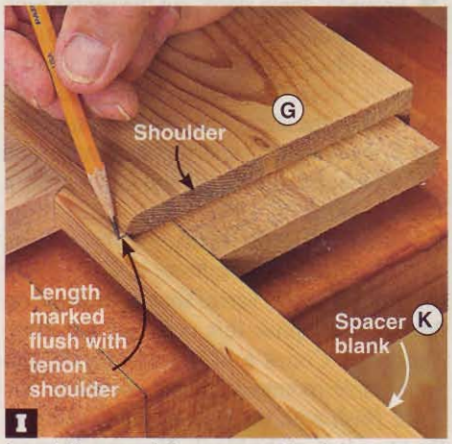
3 Mark centerlines on the front faces of the lower back rail (G), upper back rail (H), and center back slat (I). Then assemble the three parts, as shown in **Photo G**. Now insert spacers (K) and slide the back slats (J) into the lower and upper rail grooves from each end, as shown in **Photo H**. With the outside slats in place, measure the last four spacers, as shown in **Photo I**, cut them to length, and glue them in place.

ASSEMBLE THE BACK, THEN THE BENCH IN FOUR EASY STEPS



Glue and clamp the lower back rail (G), upper back rail (H), and center back slat (I), aligning the marked centerlines.

Working from both sides of the center back slat (I), alternately glue spacers (K) into the rail (G, H) grooves and add back slats (J).



Insert the remaining spacer blank into the rail groove [lower back rail (G) shown], and mark the length flush with the tenon shoulder.

Capturing the rail (F, G, H) tenons in the leg (A, B) mortises, glue and clamp the end assemblies to the front rail and back assembly.

4 Capturing the front rail (F), lower back rail (G), and upper back rail (H) tenons in the rear leg (A) and front leg (B) mortises, glue and clamp the end assemblies to the front rail and back assembly, as shown in **Photo J**. Then glue, biscuit, and clamp the remaining two brackets (D) to the front legs and front rail, where shown on **Drawing 5**.

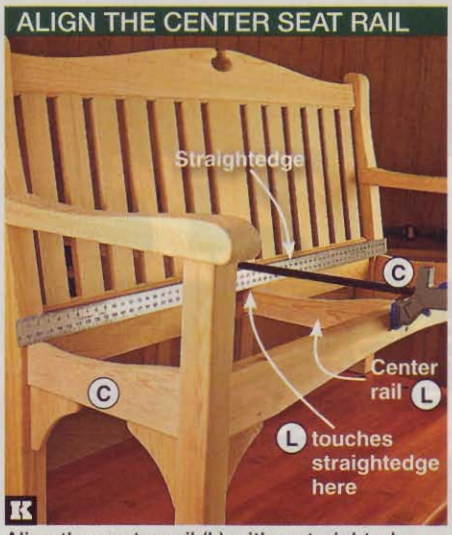
Make the seat

1 From the 1¼"-thick stock, cut the center rail (L) to size. Make a photocopy of the **Center Rail End Patterns** on the insert, and adhere them to the center rail, where shown on **Drawing 7**. Lay out the three intermediate points of the top profile where dimensioned, and connect the end patterns with a smooth line connecting the points. Then lay out the endpoints of the bottom profile and connect them with a curved line. Now bandsaw and sand the rail to shape.

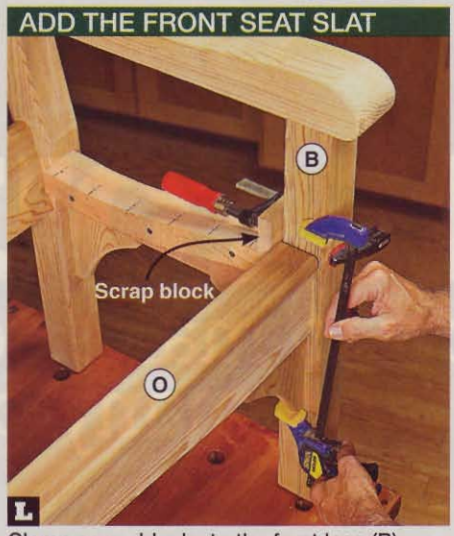
2 From the 1¼"-thick stock, cut the center cleat (M) to size. Using the center rail (L) as a template, trace the top profile onto the center cleat, and bandsaw and sand it to shape. Then draw the 1½" cleat width, where shown on **Drawing 7**, and bandsaw and sand it to shape. Retrieve the end cleats (N) and drill 5/32" shank holes in all the cleats, where shown on **Drawings 3** and **7**.

3 Clamp the center rail (L) in place, as shown in **Photo K**. Then using the shank holes in the front rail (F) and lower back rail (G) as guides, drill 3/32" pilot holes into the center rail and drive the screws. Now glue and clamp the center cleat (M) to the center rail (L) and the end cleats (N) to the end rails (C), keeping the top edges flush. Using the shank holes in the cleats as guides, drill pilot holes into the rails and drive the screws.

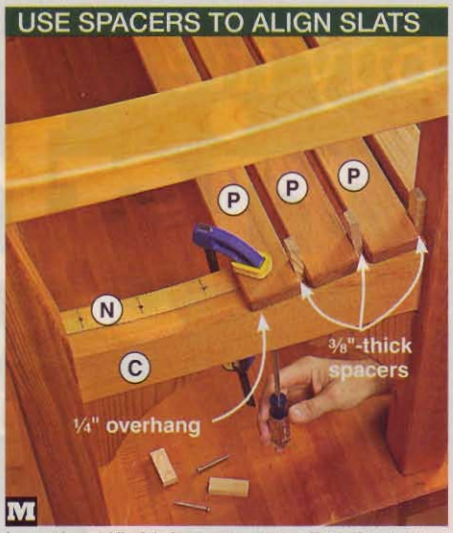
4 From ¾"-thick stock, cut the front seat slat (O) and seat slats (P) to size. Then



Align the center rail (L) with a straightedge resting on the top edges of the end rails (C). Then clamp the center rail in place.



Clamp scrap blocks to the front legs (B). Then apply glue, center the slat (O), push it against the blocks, and clamp it in place.



Inserting 3/8"-thick spacers to align the seat slats (P), clamp them in place, drill pilot holes, and screw the slats to the cleats (M, N).

cut 5/8×2 1/4" notches in the corners of the rear seat slat (P), where shown on **Drawing 5**. Rout a 3/8" round-over along the top front edge of the front seat slat. Switch to a 1/8" round-over bit and rout all the remaining ends and edges of the slats (O, P). Finish-sand the slats. Now glue and clamp the front seat slat in place, as shown in **Photo L**.

Apply finish and assemble

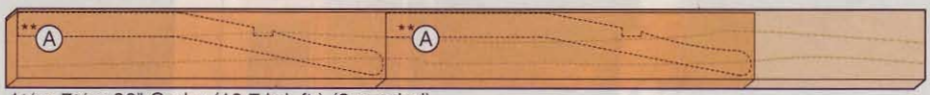
1 To plug the counterbores, chuck a 3/8" plug cutter into your drill press and cut four 7/16"-long and eight 11/16"-long plugs. Cut the plugs from scrap that matches the color of the wood around each counterbore. Glue the plugs in place. To avoid sanding away wood temporarily swollen from glue moisture, let the glue dry overnight. Then trim the plugs slightly proud of the surrounding surface and sand them smooth.

2 Inspect all the parts, and finish-sand where needed. Apply an outdoor finish. (We used Cabot Clear Solution wood finish no. 3002 Cedar, and let it dry for 24 hours.)

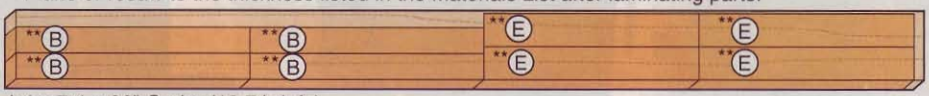
3 Cut 3/8"-thick spacers for positioning the seat slats (P). Then screw the slats in place, as shown in **Photo M**, with the slat ends overhanging the outside faces of the end rails (C) by 1/4". Now check with your feng shui consultant, position the bench in your garden landscape for maximum positive energy, and unburden your feet.

Written by **Jan Svec** with **Chuck Hedlund**
Project design: **Kevin Boyle**
Illustrations: **Roxanne LeMoine; Lorna Johnson**

Cutting Diagram



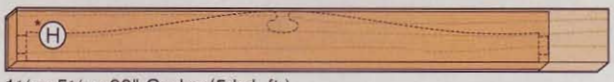
1½ x 7¼ x 96" Cedar (10.7 bd. ft.) (2 needed)
**Plane or resaw to the thickness listed in the Materials List after laminating parts.



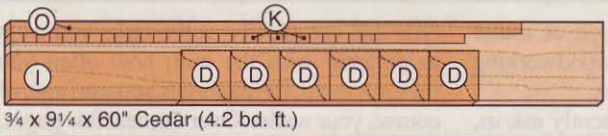
1½ x 7¼ x 96" Cedar (10.7 bd. ft.)

1½ x 5½ x 96" Cedar (8 bd. ft.) *Plane or resaw to the thickness listed in the Materials List.

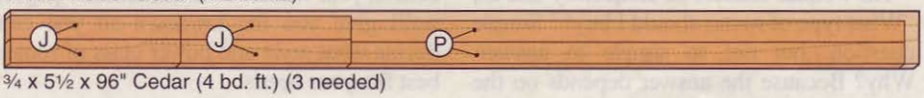
1½ x 7¼ x 96" Cedar (10.7 bd. ft.)



1½ x 5½ x 60" Cedar (5 bd. ft.)



¾ x 9¼ x 60" Cedar (4.2 bd. ft.)



¾ x 5½ x 96" Cedar (4 bd. ft.) (3 needed)

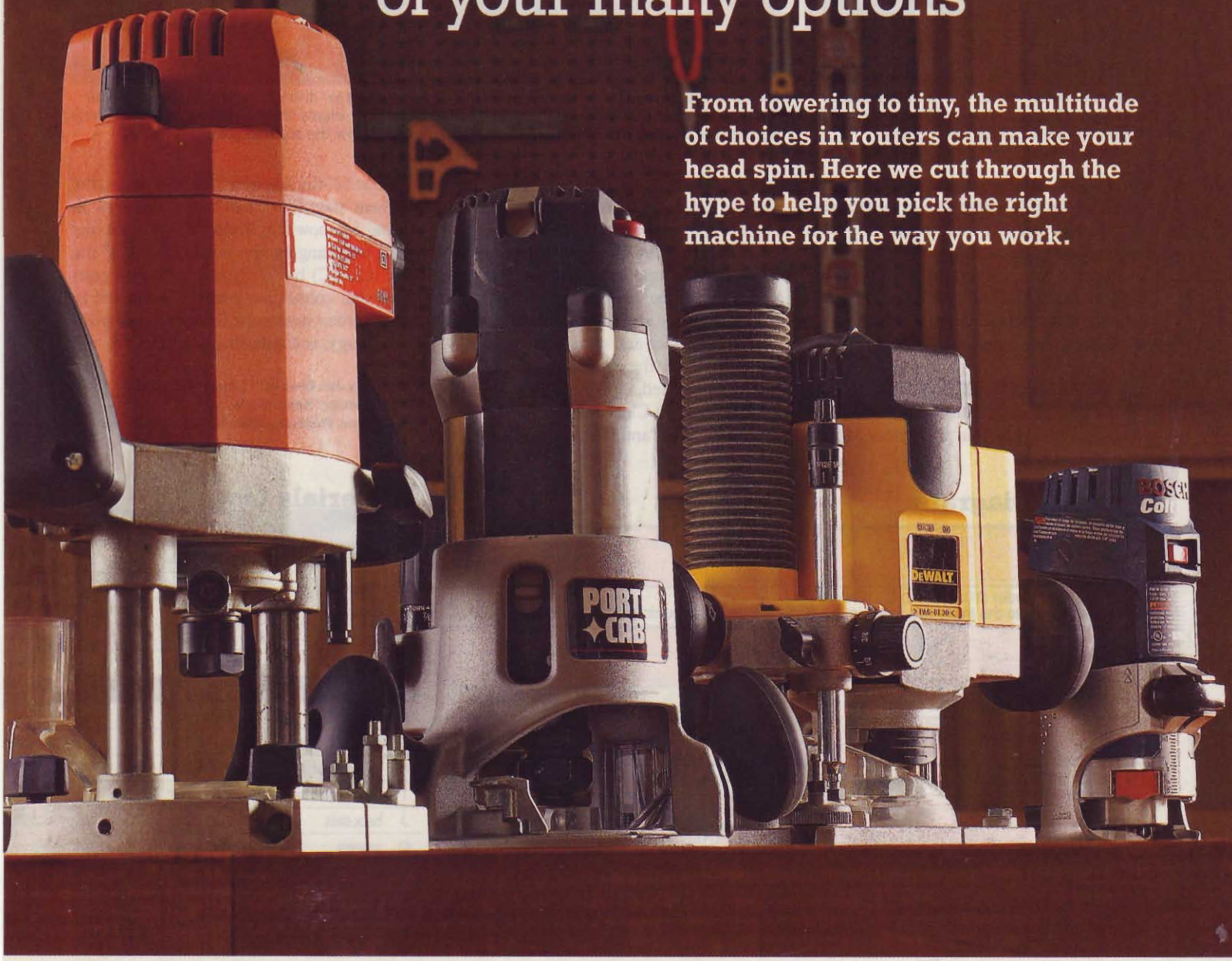
Materials List

		FINISHED SIZE T	W	L	Matl.	Qty.
End assemblies						
A*	rear legs	2½"	6⅝"	38⅝"	LC	2
B*	front legs	2½"	2½"	24¾"	LC	2
C	end rails	1¼"	4½"	17¼"	C	2
D	brackets	¾"	5¼"	5¼"	C	6
E*	arms	2½"	3¼"	22 9/16"	LC	2
Seat						
F	front rail	1¼"	4½"	56¼"	C	1
G	lower back rail	1¼"	5¼"	56¼"	C	1
H	upper back rail	1¼"	5¼"	56¼"	C	1
I	center back slat	¾"	5"	18"	C	1
J	back slats	¾"	2½"	18"	C	12
K*	spacers	¾"	1"	1⅜"	C	28
L	center rail	1¼"	3⅞"	17 3/16"	C	1
M	center cleat	1¼"	3⅛"	16 13/16"	C	1
N	end cleats	1¼"	3"	15¼"	C	2
O	front seat slat	¾"	2¼"	54"	C	1
P	seat slats	¾"	2¼"	58½"	C	6

*Parts initially cut oversize. See the instructions.
Materials key: LC–laminated cedar, C–cedar.
Supplies: #8x2" and #8x3" stainless steel deck screws, #20 biscuits, spray adhesive, polyurethane glue.
Blades and bits: Stack dado set; 1/8", 1/4", 3/8" round-over router bits; 1/2" brad-point drill bit; 3/16" drill bit 6" long; 3/8" plug cutter.

buy the right router

how to make sense of your many options



From towering to tiny, the multitude of choices in routers can make your head spin. Here we cut through the hype to help you pick the right machine for the way you work.

Without question, the router is one of the most versatile power tools in a woodworking shop. It can joint edges; cut joinery (dadoes, rabbets, splines, mortises); and trim laminates and edge banding. And a router will shape the edges and ends of a workpiece in nearly any profile. However, no single type of router performs best for every woodworking task—or for every woodworker.

No wonder readers so frequently ask us, "What type of router should I buy?" Simple question…but not so simple to answer. Why? Because the answer depends on the type and complexity of the tasks you want to perform with the tool; how often you perform them; the materials you use; and, of course, your wallet. Over the next few pages, we'll give you the lowdown so you can decide what style and power class of router best fits your needs.

MEET THE FAMILY

Before you can settle on a specific router, you need to first decide from among the four types shown *below*. And if it seems that you need more than one, buy the most versatile type—a plunge router—and add the other later.

Fixed-base Router

Power range: 1½–3¼ hp
Price range: $60–$340
Essentially a motor with handles to guide it, you set the bit depth on a fixed-base router by raising or lowering the motor within the base. On some, a threaded motor adjusts by simply twisting it; others use a height-adjustment knob. So, although the base isn't really "fixed," the cutting depth must be locked in before making a cut.
Pros: Simple adjustment; easiest to mount in jigs, fixtures, and tables; low center of gravity enhances control; most common style for router lifts; low maintenance.
Cons: Cannot easily or safely plunge the bit into a workpiece for routing mortises, stopped dadoes, etc.
What to look for: Microadjustability of cutting depth; ability to add optional bases (such as D-handle and plunge), guide bushings, and accessories; height adjustment accessible from the underside of the router for table use; adjustable or replaceable handles.

Plunge Router

Power range: 1¼–3¼ hp
Price range: $60–$400
Take the motor from a fixed-base router and mount it in a base with springs, and you have a plunge router. Because the motor slides up and down on spring-loaded posts, you adjust depth by unlocking the motor and pushing down on the handles to "plunge" the bit into the work. Plunged and locked, it functions like a fixed-base machine.
Pros: Easy to lower bit into work for mortises or stopped flutes and dadoes; ability to make multiple passes for deep cuts without additional setup; excels at sign-making.
Cons: Top-heavy; can be difficult to adjust bit height when table-mounted; plunge-depth mechanism can be difficult to learn for beginners.
What to look for: Ability to use guide bushings and other accessories; easy-to-use locking mechanism; precise, adjustable depth stop; ability to "zero out" depth stop for ease of setting cutting depth.

Combination Kit

Power range: 1½–2¼ hp
Price range: $100–$300
A combo kit includes one motor that fits either a fixed or plunge base, both of which come with the kit. If a fixed-base machine suits most of your work, but you occasionally cut mortises or stopped dadoes, a combo kit may be an economical solution for you.
Pros: Almost like having a second router, but at a lower cost; fixed base can remain mounted in router table while you use the plunge base for freehand work.
Cons: Swapping bases can grow tiresome; if you need a high-power router for large-diameter bits (over 2") you won't find one here—most combo kits top out at only 2¼ hp.
What to look for: All the same things you'd want from either a fixed-base or plunge router.

Trim Router

Power range: 1 hp or less
Price range: $60–$100
Sometimes called laminate trimmers, these small fixed-base tools accept only ¼"-shank bits. Most trim routers don't have handles—you grip the motor itself. For light-duty work, such as round-overs, hinge mortising, chamfering, and (of course) laminate trimming, they're perfect.
Pros: Lightweight and easy to handle; great for small work; inexpensive; specialized bases available for trimming.
Cons: Low power; can't use ½"-shank or large-diameter bits; depth adjustment limited (about 1" typical).
What to look for: Ability to use guide bushings; comfortable grip; low center of gravity.

Deal makers and breakers

Although a basic motor-with-handles router was the norm a decade or two ago, today's woodworker demands more features. Enhancements, such as soft-start, variable-speed motors and self-releasing collets, make routers more versatile and easier to use. So, once you choose a type of router, decide how much you need each of these features:

■ **Power.** A 1½- to 2¼-hp router works well as a general-purpose machine, but if you'll often use bits larger than about 2" in diameter to make, say, raised-panel doors, consider a 3-hp-class machine. Remember that having a lot of horsepower doesn't mean you can just hog out as much material as you want; for safety and efficiency, it's best to take multiple lighter passes. More power does mean that heavier cuts will put less stress on you and the router.

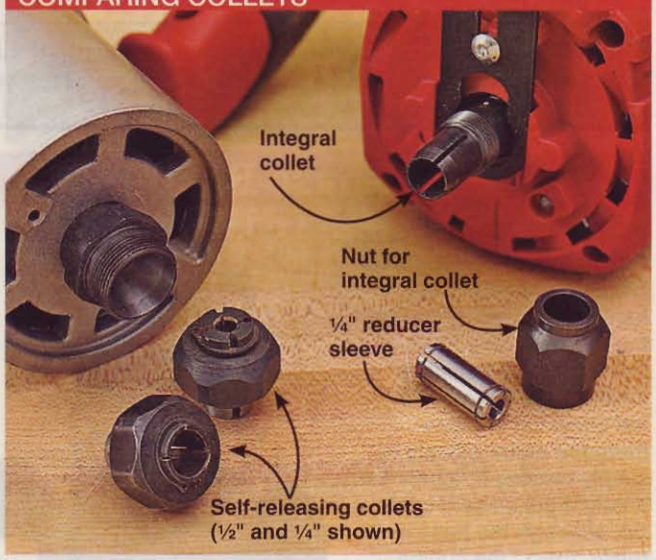
■ **Variable speed.** Router bits have recommended speed limits, depending on their diameter. (The tips of a 2½" bit spinning at 21,000 rpm travel at 156 miles per hour; a 1" bit at the same motor speed moves only 62 mph.) Dialing down the motor increases safety with large bits and gives you better control. Also, variable speed allows you to slow the cutter speed on easily burnable woods like cherry.

■ **Electronic speed control.** Like cruise control for your router, this circuitry helps the motor maintain constant speed under varying workload. Without it, the motor can bog down and give a rough cut in dense woods.

■ **Soft start.** A router's torque can really kick when powered up in handheld operations. Soft start ramps the speed up quickly, but minimizes that kick. This feature becomes even more important with 3-hp-range machines, or if your router requires you to let go of a handle to reach the switch. Most machines with electronic speed control also have soft start.

■ **Collets.** Even if every bit you currently own has the same size shank, stick with a machine that has collets to accept both ¼" and ½" shanks, or at least offers the second size as an optional accessory. (Some small profile bits come only with ¼" shanks.) Collets described as "self-releasing" free the bit after one full turn of the collet nut,

COMPARING COLLETS



Some low-cost routers use an integral collet mounted to the end of the motor shaft. Most, however, have separate self-releasing collets. To use smaller bits, you'll either change to a separate ¼" collet or insert a reducer sleeve in the ½" collet.

TWO SWITCH STYLES, BOTH GOOD

The power switch should be within easy reach without letting go of the router. Porter-Cable's 890-series fixed-base router has a dual-position switch that works well both when handheld and inverted in a router table. Skil's trigger switch keeps power control literally at your fingertips for handheld use, but is more difficult to activate and lock when table-mounted.

making bit changing easier. Steer clear of routers with integral collets, like the one shown at *left*; should a bit seize in that collet, you'll have to replace the entire router, not just the bit and collet.

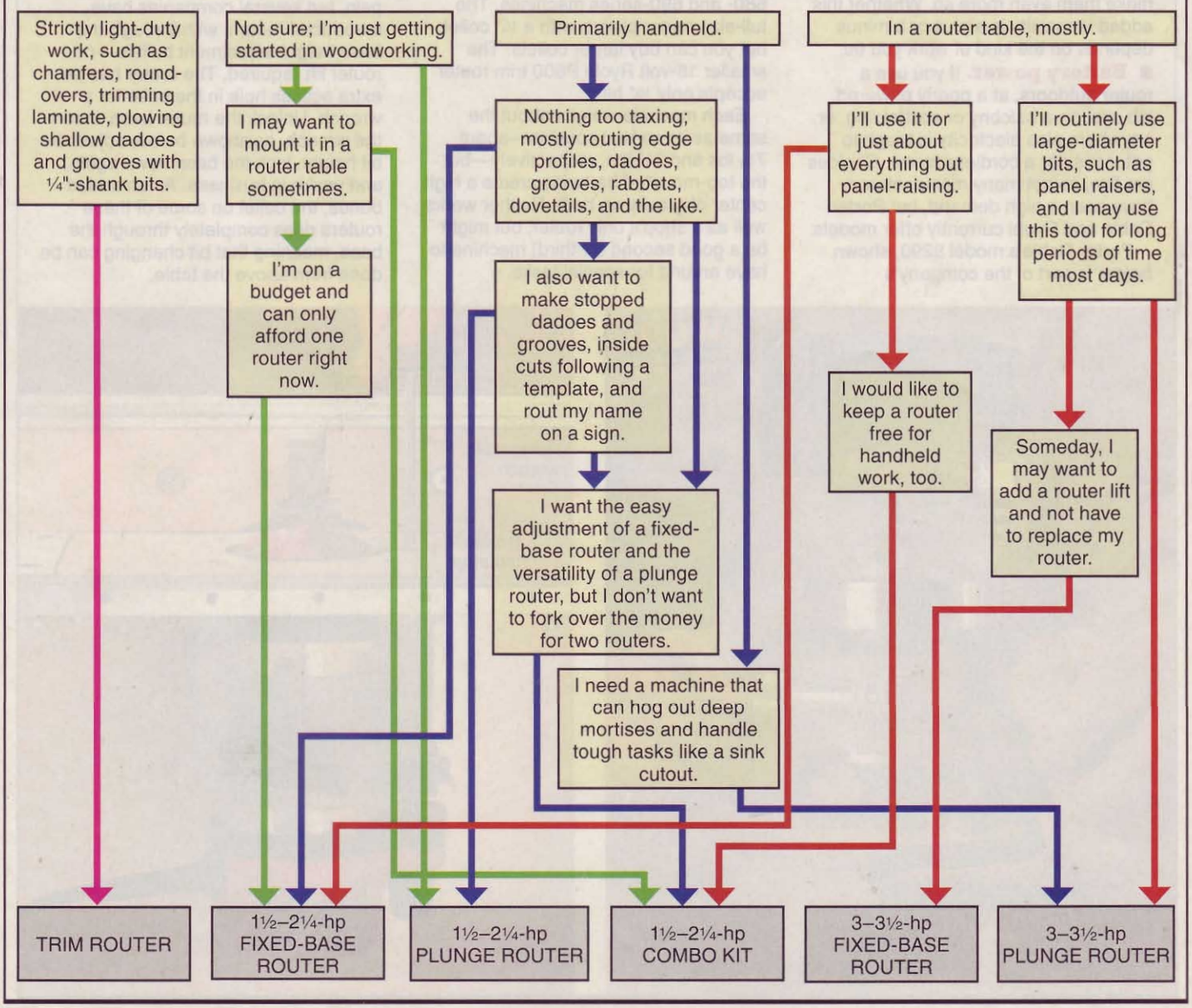
■ **Dust collection.** It was once considered a luxury, but we now wouldn't own a router without a dust-collection port. Some come standard, some are optional, and some manufacturers don't even offer them as accessories, so check it out before you buy. Usually you connect a vacuum hose to a port mounted on top of the router's base, which works fine for most applications; if you routinely rout edge treatments, consider a router that accepts a below-the-base dust-collection port.

■ **Switch style/location.** You should be able to engage the switch without letting go of a handle, but some models still require this. A few switches are accessible from the top or bottom of the router, making them more adaptable to table use. Routers that twist to adjust bit height can relocate the switch every time you adjust the height, an inconvenience in router-table use.

■ **Handles.** Personal preference reigns here. You'll find base-mounted knobs and motor-mounted pistol-grip handles, and everything in between. Try several, looking specifically for good balance and sure control in handheld operation; if it doesn't feel right, keep shopping. For fixed-base routers, a D-handle base gives the greatest control in handheld operations, and usually has the power switch directly under your forefinger at all times. Some combo kits offer a D-handle base in addition to plunge and knob-style fixed bases.

Road map for finding your way through the router forest

Now that you know more about the different styles of routers and the important features, it's time to decide which style and power class suits the way you work. Like a trail of bread crumbs, this chart will lead you to the right machine.


How will you use this router most?
Strictly light-duty work, such as chamfers, roundovers, trimming laminate, plowing shallow dadoes and grooves with ¼"-shank bits.
Not sure; I'm just getting started in woodworking.
Primarily handheld.
In a router table, mostly.
I may want to mount it in a router table sometimes.
Nothing too taxing; mostly routing edge profiles, dadoes, grooves, rabbets, dovetails, and the like.
I'll use it for just about everything but panel-raising.
I'll routinely use large-diameter bits, such as panel raisers, and I may use this tool for long periods of time most days.
I'm on a budget and can only afford one router right now.
I also want to make stopped dadoes and grooves, inside cuts following a template, and rout my name on a sign.
I would like to keep a router free for handheld work, too.
Someday, I may want to add a router lift and not have to replace my router.
I want the easy adjustment of a fixed-base router and the versatility of a plunge router, but I don't want to fork over the money for two routers.
I need a machine that can hog out deep mortises and handle tough tasks like a sink cutout.
TRIM ROUTER
1½–2¼-hp FIXED-BASE ROUTER
1½–2¼-hp PLUNGE ROUTER
1½–2¼-hp COMBO KIT
3–3½-hp FIXED-BASE ROUTER
3–3½-hp PLUNGE ROUTER

Pro vs. DIY routers: Why pay the difference?

Higher-priced routers have more metal parts than plastic, higher power, and advanced features, such as built-in height adjustment, soft-start, variable speed, and interchangeable bases. They also cost more than routers without. That said, a low-cost router makes good sense if you use it only a few times a year. Less-expensive routers don't have components to stand all-day-every-day use and abuse.

Many woodworkers start with a do-it-yourself (DIY) router, and then graduate to a pro router for more demanding tasks, such as regularly making raised door panels or hundreds of feet of profiled moldings.

The quality of the internal workings separates pro-level routers from DIY models. Larger bearings and beefier motor components help the pro model run cooler and last longer.

Router (r)evolution: The latest trends in these tools

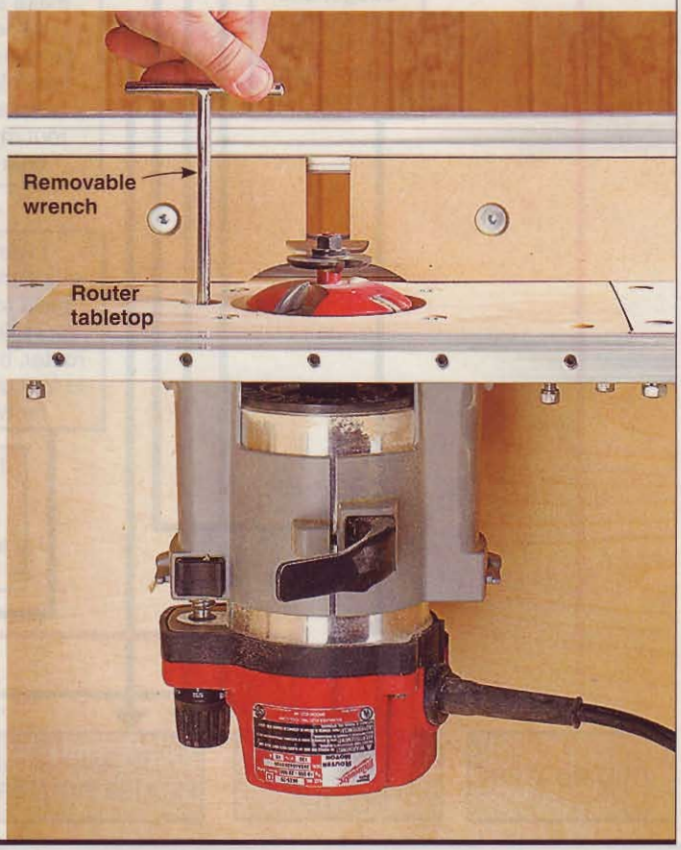
As if routers weren't already versatile right out of the box, manufacturers are always coming up with innovations to make them even more so. Whether this added versatility is a plus or a minus depends on the kind of work you do.

■ **Battery power.** If you use a router outdoors, at a poorly powered job site, on a balcony or scaffolding, or anywhere else electricity is tough to get, consider a cordless router. Choices are few, as not many manufacturers have seen a high demand, but Porter-Cable and Ryobi currently offer models.

Porter-Cable's model 9290, shown *below*, is part of the company's 19.2-volt line, and performs the same work as a 1½-hp router. And, it's compatible with bases used by the P-C 680- and 690-series machines. The full-size router comes with a ¼" collet, but you can buy larger collets. The smaller 18-volt Ryobi P600 trim router accepts only ¼" bits.

Each machine weighs about the same as its corded cousins—about 7¾ lbs and 2¼ lbs, respectively—but the top-mounted batteries create a high center of gravity on both. Neither works well as a shop's only router, but might be a good second (or third) machine to have around for special tasks.

■ **Through-the-base bit height adjustment.** Working under a router table to adjust bit height can be a royal pain, but several companies have introduced routers with through-the-base height adjustment built in—no router lift required. The router has an extra access hole in the base for a wrench. Unlock the router base, insert the wrench, as shown *below*, adjust the bit height, lock the base down again, and you're in business. As an added bonus, the collet on some of these routers rises completely through the base, meaning that bit changing can be done from above the table.



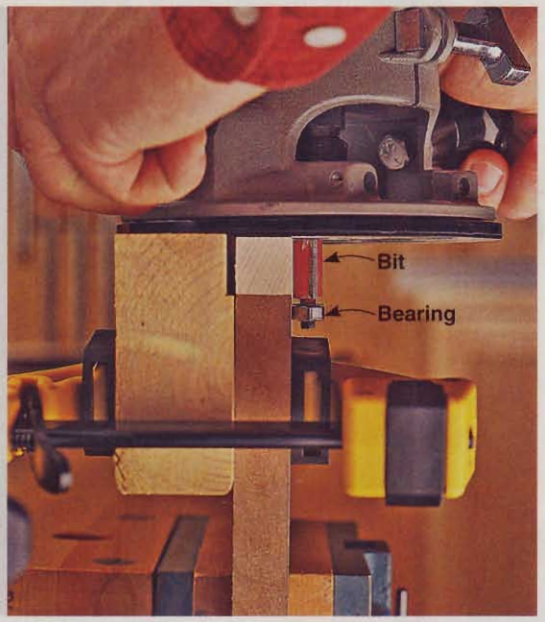
Accessories to keep your router on track

For smooth and straight cuts, a router table with a fence does the trick when you can take the workpiece to the router, but you need a more portable solution when taking the router to the workpiece. Here are four common ways to achieve perfect cuts by guiding along a solid edge.

1 An **edge-guide fence** attaches to the router base. It keeps the router on a path parallel to the edge of a workpiece, using the edge itself as a reference. An edge-guide fence works best for edge treatments and slots, grooves, or flutes fairly close to the edge (usually 12" or less). They can handle gentle curves, but work best on straight edges.

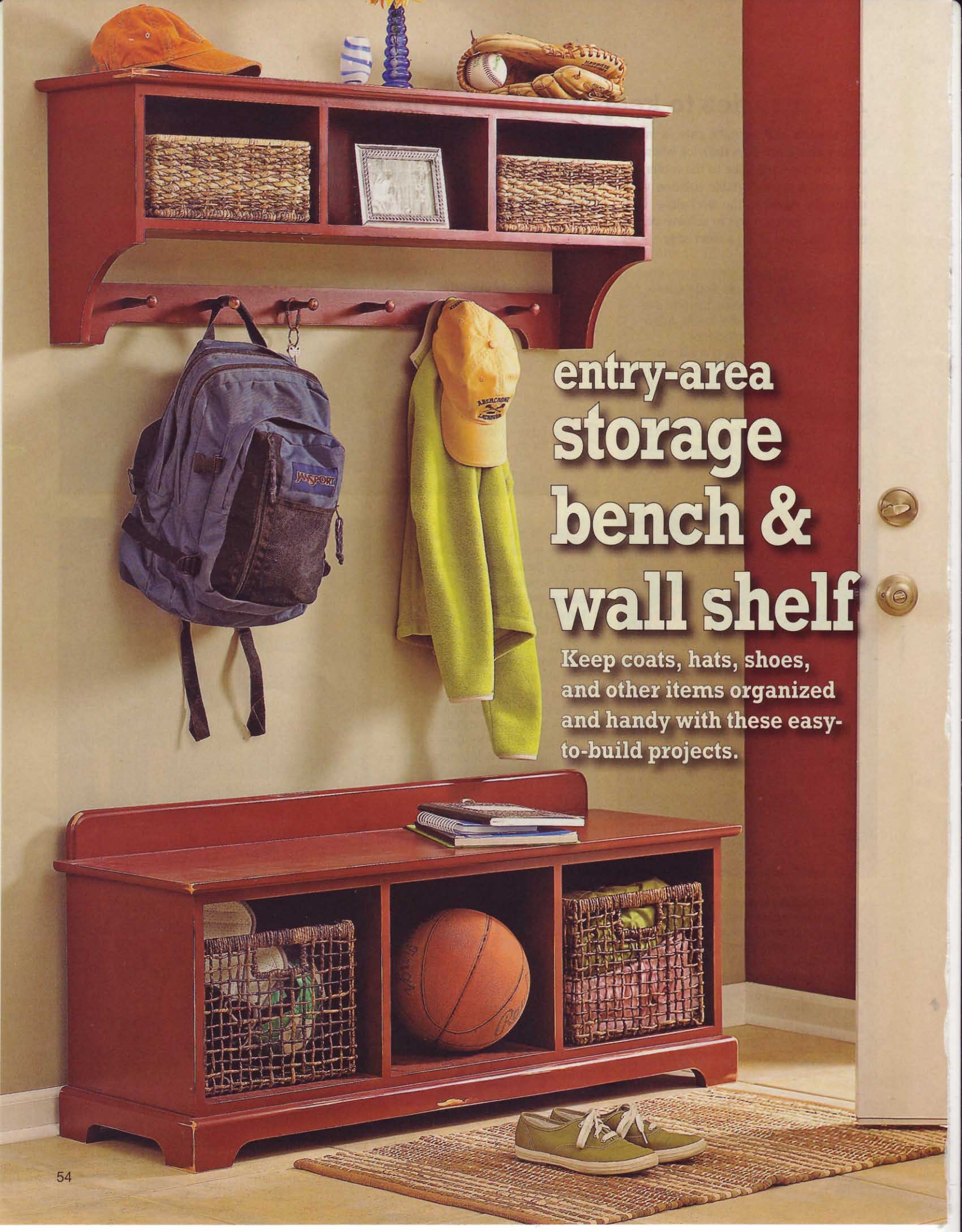
2 For cutting grooves and dadoes in larger workpieces, beyond the reach of an edge-guide fence, a low-tech but effective method for achieving straight cuts is a **clamp-on straightedge**. Whether a commercial version or simply a straight piece of wood, as shown *below*, it clamps onto a workpiece and acts as a fence. You run the router along its length to make the cut. When used with a stop, these are especially good for routing stopped dadoes.

3 For flush-trimming, template, or profile work, it's hard to beat a **bearing-guided bit**. A small wheel mounted above or below the cutters rolls along the template or workpiece edge to guide the bit, as shown at *right*. Some cutters, such as rabbeting bits, have interchangeable wheels that can vary the depth of the cut. Unlike edge guides and clamp-on straightedges, these bits aren't limited to cutting in a straight line—they can easily follow intricate curves.



4 Similar to bearing-guided bits, **guide bushings** follow a template just like tracing a pattern. They mount to the underside of the router base and are useful for cutting numerous repetitive shapes, especially on interior portions of a workpiece. For sign-making, guide bushings and a plunge router make a great team.

Written by **A.J. Hamler** with **Dave Campbell**



entry-area storage bench & wall shelf

Keep coats, hats, shoes, and other items organized and handy with these easy-to-build projects.

AT A GLANCE

- Storage bench overall dimensions: 47" wide × 15" deep × 20¾" high.
- Wall shelf overall dimensions: 47" wide × 10½" deep × 16¾" high.

Looking to craft some stylish projects that won't cost you a pretty penny for materials? You can make these matching pieces using inexpensive ¾" edge-joined pine panels, ¼" birch plywood, and a pine 2×4—all available at your local home center. Depending on your preference, you can finish the projects with a clear finish or paint to match your decor. For a timeworn appearance, we applied an antique red finish and distressed it, as explained on *page 57*, using a simple two-part paint product that you'll also find at your home center for under $15. We'll start with the storage bench. You'll find the wall shelf on *page 58*.

Let's start with the storage bench

Make the simple case

***Note:** Because the storage bench and wall shelf have the same basic case construction, you can avoid repeat setups by machining similar parts at the same time.*

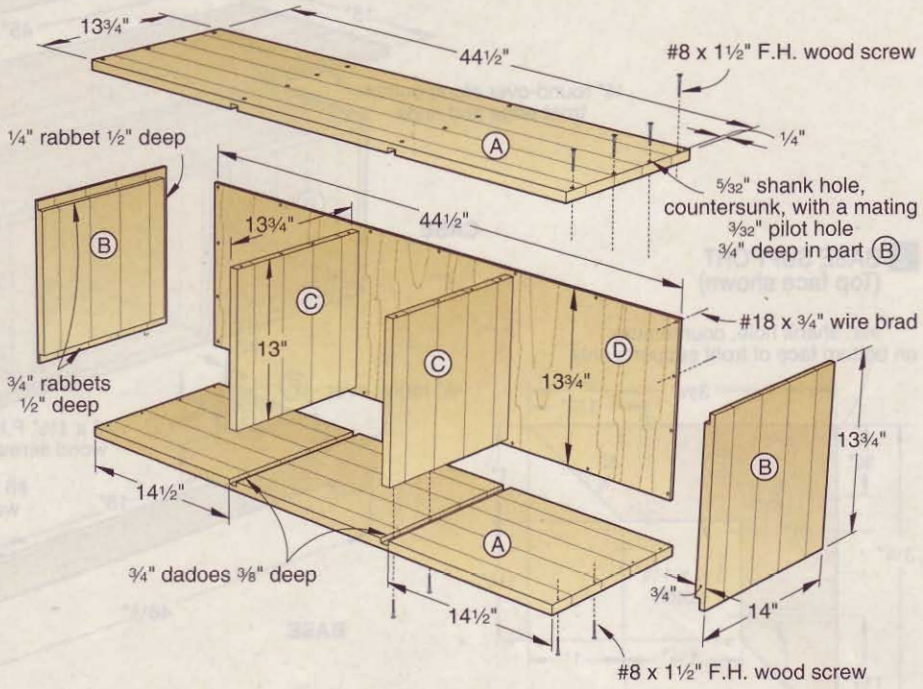
1 From ¾"-thick edge-joined pine panels, cut the top and bottom (A), sides (B), and dividers (C) to the sizes listed in the **Materials List**.

2 Using a dado blade in your tablesaw that matches the thickness of your panels, cut two ⅜"-deep dadoes on the *inside* faces of the top and bottom (A), where dimensioned on **Drawing 1**. Next, raise the blade to ½", attach an auxiliary fence to the rip fence, and position the fence adjacent to the blade. Then cut rabbets along the ends of each side (B) on the *inside* faces, where shown. Switch to a ¼" dado blade, and reposition the fence adjacent to the blade. Now cut a ½"-deep rabbet along the back edge of each side to receive the plywood back (D).

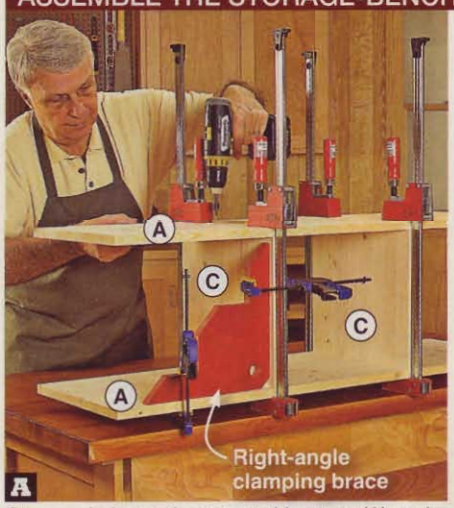
3 Sand the top and bottom (A), sides (B), and dividers (C) to 220 grit. To assemble the case, glue and clamp the top, bottom, and dividers together, using a right-angle clamping brace to keep the assembly square, as shown in **Photo A**. (For a free clamping brace plan, go to woodmagazine.com/brace.) Drill mounting holes through the top and bottom and centered into the dividers, where shown on **Drawing 1**. Drive the screws. After the glue dries, glue and clamp the sides in place, as shown in **Photo B**. Drill mounting holes through the top and bottom into the sides, and drive the screws.

4 From ¼" plywood, cut the back (D) to size to fit the case opening. For ease of finishing, you'll install the back later.

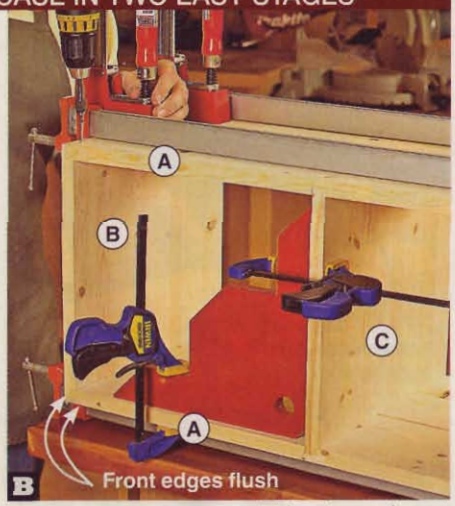
1 STORAGE-BENCH CASE



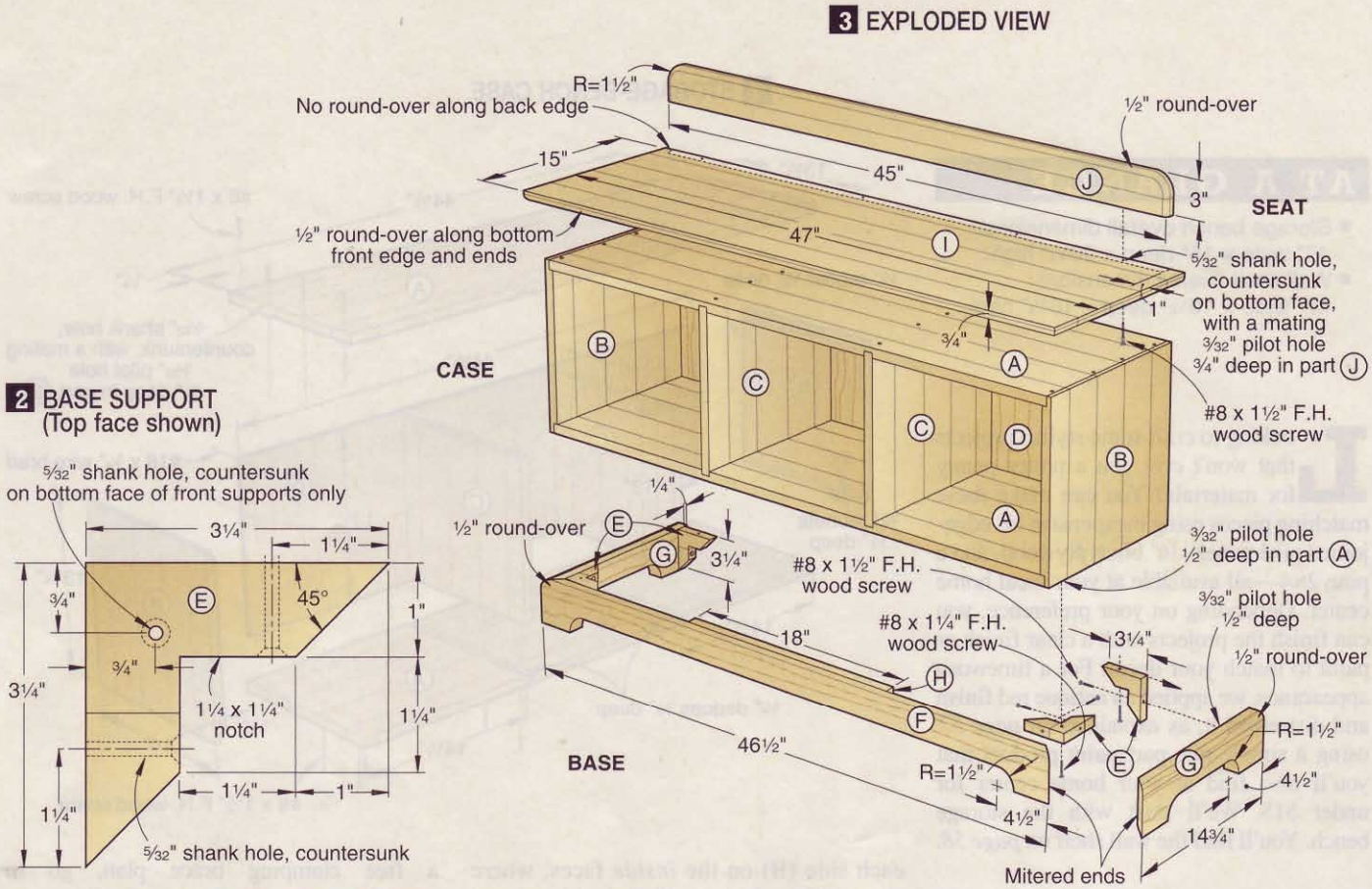
ASSEMBLE THE STORAGE-BENCH CASE IN TWO EASY STAGES



Glue and clamp the top and bottom (A) and dividers (C) together. Then drill mounting holes and secure the parts with screws.



Keeping the front edges flush, glue and clamp the sides (B) to the case (A/C). Drill mounting holes, and drive the screws.



Now add the base

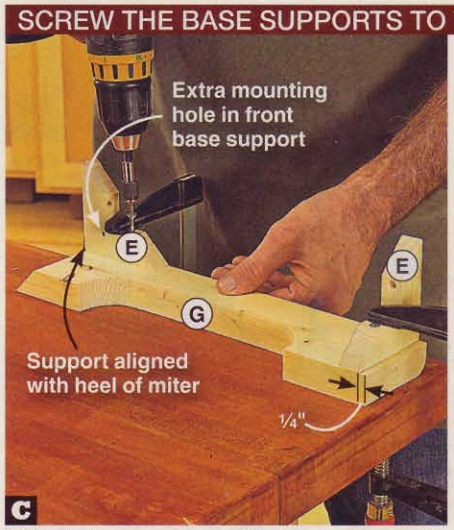
1 From your edge-joined panels, cut two 3¼×3¼" blanks to form the base supports (E). (You'll cut two supports from each blank.) Draw a diagonal line on one face of each blank. Then, to lay out the 1¼×1¼" notches for the supports, where dimensioned on **Drawing 2**, draw a 1¼" square, centered, on each blank. Bandsaw or scrollsaw the blanks along the diagonal lines to separate the supports. Now cut the notch in each support to shape.

2 Mark centerpoints for countersunk shank holes on each support (E), where dimensioned, noting the additional hole on the *bottom* face for the two *front* supports. Drill the holes.

3 To form the base front (F) and base sides (G), joint one face and edge of an 8'-long pine 2×4, removing the round corners. Then plane the board to 1" thick and rip it to 3¼" wide. Now miter-cut the base front and sides to length, where shown on **Drawing 3**.

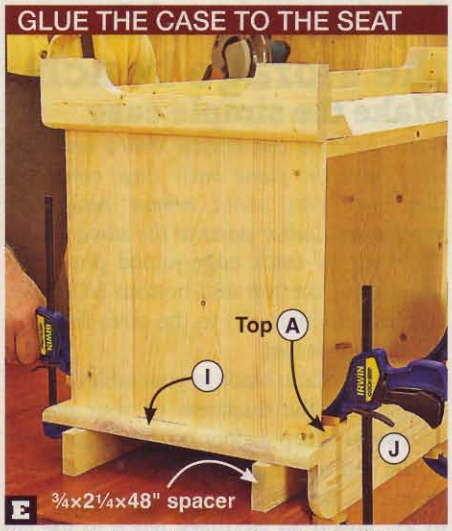
4 Lay out the cutouts with 1½" radiused ends on the base front and sides (F, G), where dimensioned. Now bandsaw and sand the cutouts to shape.

5 Using a ½" round-over bit in your table-mounted router, round over the *top* edges



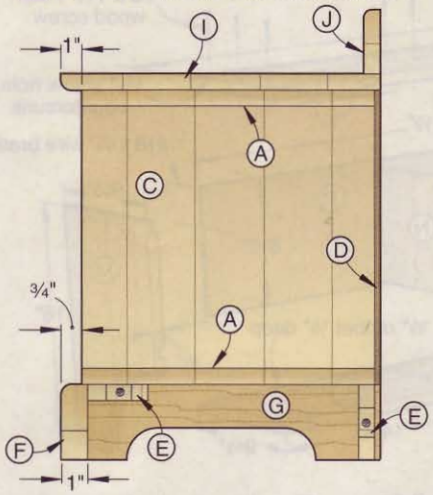
With the base supports (E) clamped in position on the base side (G) as shown, drill pilot holes into the side and drive the screws.

Then glue and clamp each base side/support assembly (G/E) to the base front (F). Drill pilot holes, and drive the screws.



Glue and clamp the case to the seat/rail assembly (I/J) with the case centered side-to-side and flush at the back.

4 BENCH FRONT SECTION VIEW



of the base front and sides on the *outside* faces. Keep the router setup for use later.

6 To assemble the base, glue and clamp a front and back base support (E) to each base side (G), where shown on **Drawing 3** and as shown in **Photo C**. Align the front base supports (the ones with the extra countersunk mounting hole on the bottom face) with the heels of the miter-cut ends of the base sides. Position the back base supports ¼" from the square ends of the base sides. Using the mounting holes in the supports as guides, drill pilot holes into the base sides and drive the screws.

Next, glue and clamp the base side/support assemblies (G/E) to the base front (F), verifying tight mitered corners and 90° angles. Drill pilot holes and drive the screws through the supports into the base front, as shown in **Photo D**. Sand the base smooth.

7 To mount the base (E/F/G) to the case, place the case on your workbench with the bottom (A) up. Apply a small amount of glue to the top faces of the base supports (E). Now position the base on the case, centered side-to-side and flush at the back, where shown on **Drawing 4**, and clamp it in place. Using the holes in the front and back base supports as guides, drill pilot holes into the case bottom. Drive the screws.

8 To reinforce the base front (F), cut the base-front support (H) to size from an edge-joined panel. Glue and clamp the support, centered side-to-side, to the back face of the base front and tight against the case bottom (A), where shown on **Drawing 3**.

Top it off with the seat

1 From edge-joined panels, cut the seat (I) and seat rail (J) to the sizes listed. Draw a 1½" radius at each end of the rail, where shown on **Drawing 3**. Bandsaw and sand the top corners to shape.

2 Using your router table, rout a ½" round-over along the ends and front edge of the seat (I) on the *bottom* face and along the ends and top edge of the seat rail (J) on the *front* face, where shown. Sand the parts smooth.

3 Glue and clamp the seat rail (J) to the seat (I), centered side-to-side and flush at the back. Drill mounting holes through the seat and into the rail, where shown, and drive the screws.

4 To assemble the seat/rail assembly (I/J) to the case, cut two 2¼x48" spacers from ¾" scrap. (The spacers provide clearance for clamping.) With the bottom face up, place the seat/rail assembly on the spacers, as shown in **Photo E**. Apply glue to the case top (A). Now position the case on the seat, centered side-to-side and flush at the back, and clamp in place, as shown.

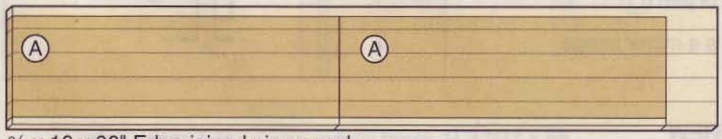
Finish up

1 Finish-sand any areas that need it to 220 grit, and remove the dust.

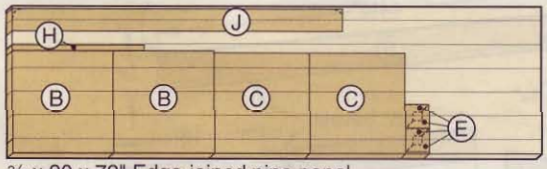
2 Finish the bench and plywood back (D) as you wish using a clear finish or stain-blocking primer and paint. (If applying a clear finish, use polyurethane for best moisture protection.) For an aged look, we applied Rust-Oleum American Accents Distressed Antique Vintage Red finish, following the manufacturer's simple three-step process for applying the red base coat, sanding to distress the surfaces and edges using the supplied abrasive sponge, and sealing with the antiquing topcoat.

3 Finally, place the back (D) in position and secure it to the case with #18x¾" wire brads, where shown on **Drawing 1**. Now fill the bench with shoes, gloves, school backpacks, or other items, placing them in baskets, if you wish, that fit the cubbies. For help finding baskets, see **Sources**.

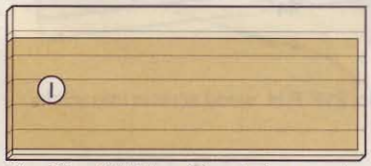
Cutting Diagram



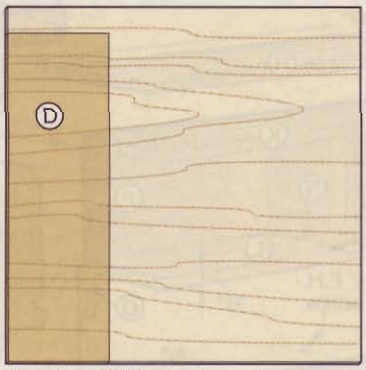
¾ x 16 x 96" Edge-joined pine panel
NOTE: Parts are centered over joint lines for best appearance.



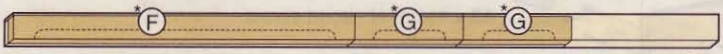
¾ x 20 x 72" Edge-joined pine panel



¾ x 20 x 48" Edge-joined pine panel



¼ x 48 x 48" Birch plywood



1½ x 3½ x 96" (2x4) Pine *Plane to the thickness listed in the Materials List.

Materials List

Storage bench		FINISHED SIZE T	W	L	Matl.	Qty.
A	top and bottom	¾"	13¾"	44½"	EP	2
B	sides	¾"	14"	13¾"	EP	2
C	dividers	¾"	13¾"	13"	EP	2
D	back	¼"	44½"	13¾"	BP	1
E	base supports	¾"	3¼"	3¼"	EP	4
F*	base front	1"	3¼"	46½"	P	1
G*	base sides	1"	3¼"	14¾"	P	2
H	base-front support	¾"	¾"	18"	EP	1
I	seat	¾"	15"	47"	EP	1
J	seat rail	¾"	3"	45"	EP	1

*Parts initially cut oversize. See the instructions.
Materials key: EP–Edge-joined pine panel, BP–birch plywood, P–pine.
Supplies: #8x1¼" flathead wood screws (2), #8x1½" flathead wood screws (44), #18x¾" wire brads.
Blade and bit: Dado-blade set, ½" round-over router bit.

Sources

Baskets: We found baskets that fit into the 14"-wide x 12¼"-high x 13¾"-deep cubbies in the storage bench and 14"-wide x 7½"-high x 8¾"-deep openings in the wall shelf at a local World Market (worldmarket.com). Other sources for baskets include Pottery Barn (potterybarn.com), Michaels (michaels.com), Pier 1 Imports (pier1.com), and Holdeverything (holdeverything.com). Baskets from these sources may vary in size.

Complement the storage bench on *page 55* with this matching unit that has an interlocking cleat system for convenient wall mounting.

Now let's build the wall shelf

Start with the case

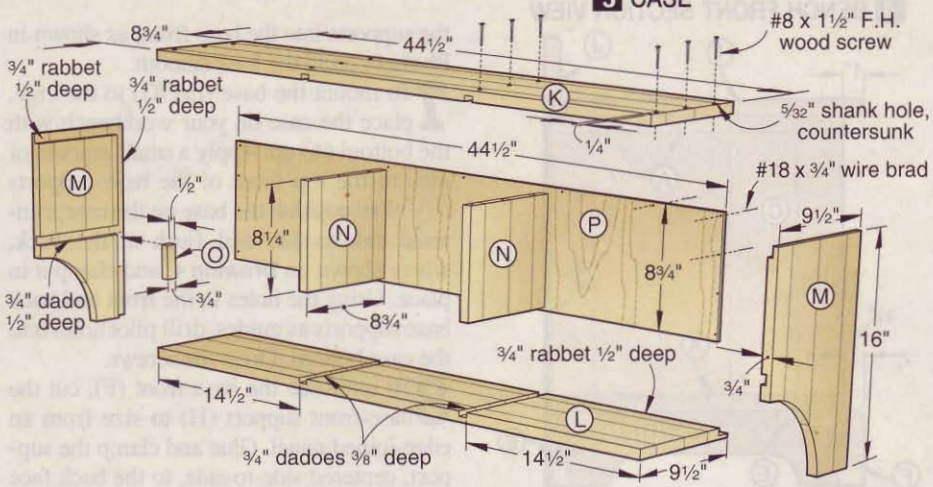
1 From ¾"-thick edge-joined pine panels, cut the top (K), bottom (L), sides (M), and dividers (N) to the sizes listed in the **Materials List**.

2 Using a dado blade in your tablesaw that *matches the thickness of your panels*, cut two ⅜"-deep dadoes on the *inside* faces of the top (K) and bottom (L), where dimensioned on **Drawing 5**. Next, raise the blade to ½". Then cut a dado on the *inside* face of each side (M), where dimensioned on **Drawing 6**, to receive the bottom.

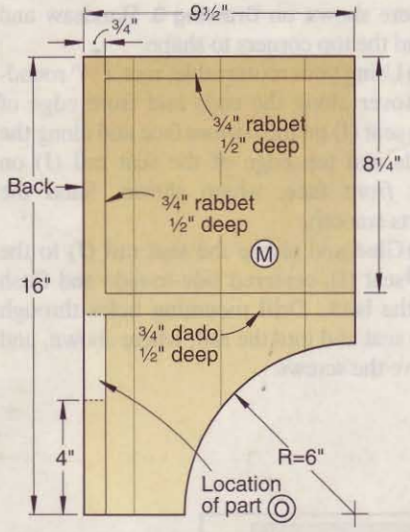
Next, attach an auxiliary fence to the rip fence, and position the fence adjacent to the blade. Now cut a ¾" rabbet ½" deep along the top and back edges of each side on the *inside* face and the back edge of the bottom on the *inside* face. The rabbeted back edges of the sides and bottom receive the ¼" plywood back (P) and ½"-thick case cleat (S), where shown on **Drawing 7a**.

3 From a piece of edge-joined panel planed to ½" thick, cut the fillers (O) to the size listed. Then glue and clamp a filler in the ¾" rabbet along the back edge of each side (M), flush with the bottom edge of the ¾" dado for the bottom (L), where shown on **Drawings 5** and **6** and as shown in **Photo F**. Sand the fillers flush with the sides.

5 CASE



6 SIDE
(Inside face of right side shown)

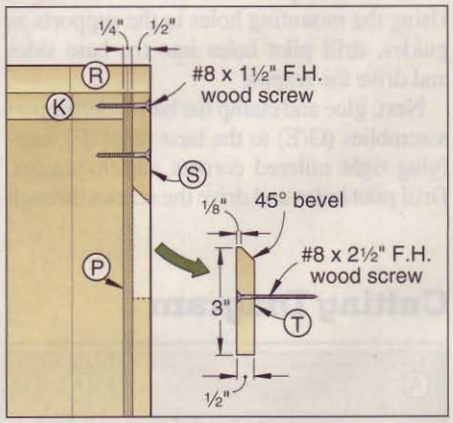


Note: Left side (M) is a mirror image.

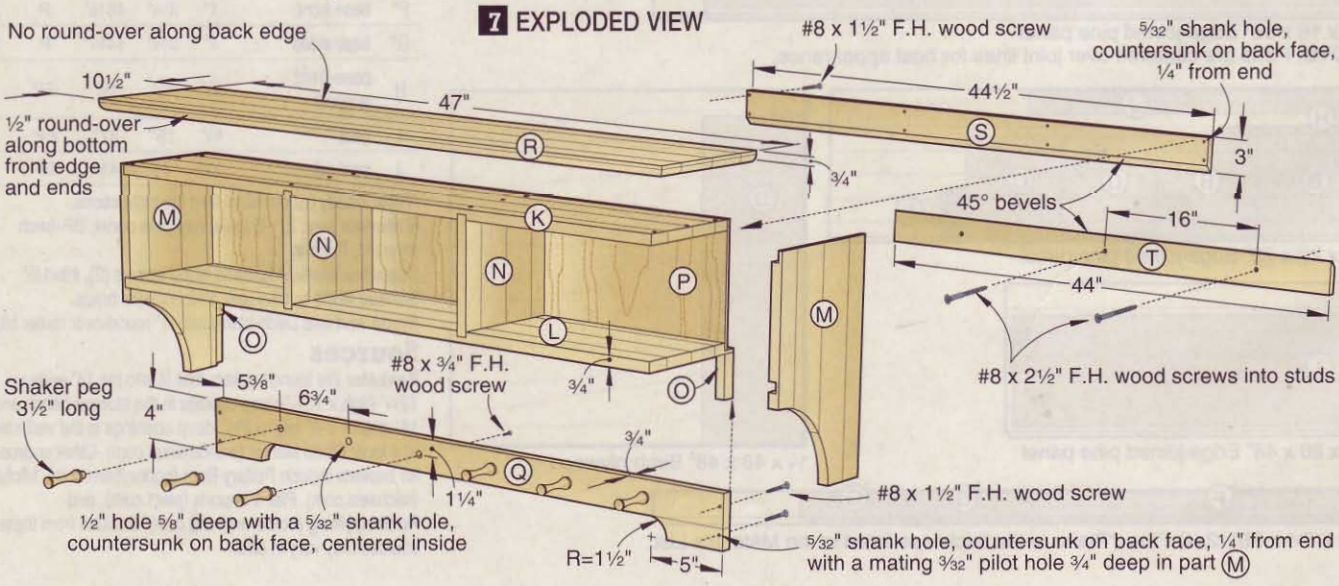
4 Draw a 6" radius on the bottom front corner of each side (M), where shown on **Drawing 6**. Bandsaw and sand to the marked line.

5 Sand the top (K), bottom (L), sides (M), and dividers (N) to 220 grit. To assemble *the case, glue and clamp the top, bottom,* and dividers together, using a right-angle clamping brace to keep the assembly

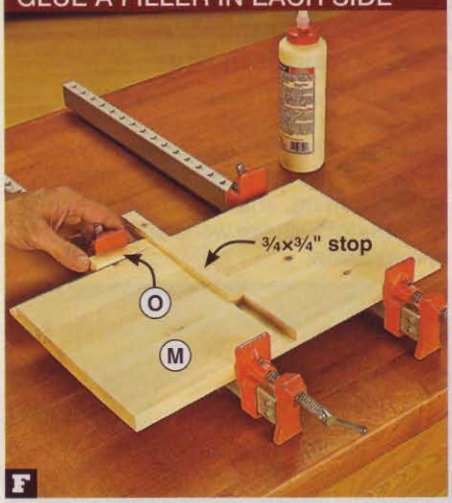
7a CLEAT MOUNTING DETAIL



7 EXPLODED VIEW

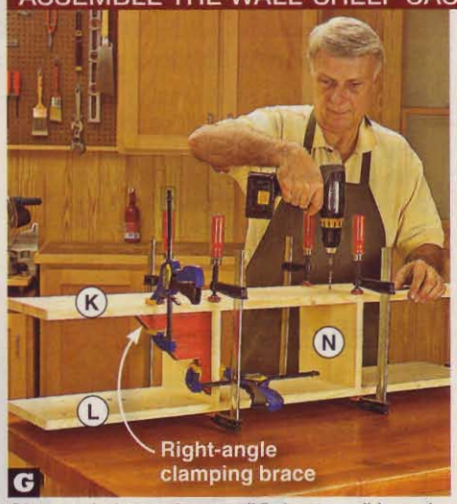

No round-over along back edge
10½"
47"
½" round-over along bottom front edge and ends
#8 x 1½" F.H. wood screw
5⁄32" shank hole, countersunk on back face, ¼" from end
44½"
3"
¾"
45° bevels
16"
44"
#8 x 2½" F.H. wood screws into studs
Shaker peg 3½" long
4"
5⅜"
6¾"
#8 x ¾" F.H. wood screw
¾"
¾"
1¼"
#8 x 1½" F.H. wood screw
½" hole ⅝" deep with a 5⁄32" shank hole, countersunk on back face, centered inside
R=1½"
5"
5⁄32" shank hole, countersunk on back face, ¼" from end with a mating 3⁄32" pilot hole ¾" deep in part (M)

GLUE A FILLER IN EACH SIDE

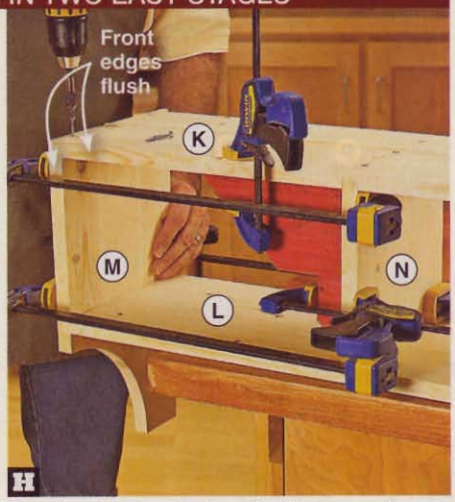


Using a ¾x¾" scrap for a stop in the dado in a side (M), glue and clamp a filler (O) in the rabbet, tight against the stop.

ASSEMBLE THE WALL-SHELF CASE IN TWO EASY STAGES



Glue and clamp the top (K), bottom (L), and dividers (N) together. Then drill mounting holes and screw the top to the dividers.



Keeping the front edges flush, glue and clamp the sides (M) to the case (K/L/N). Drill mounting holes, and drive the screws.

square, as shown in **Photo G**. (For a free clamping brace plan, go to woodmagazine.com/brace.) Drill mounting holes through the top and centered into the dividers, where shown on **Drawing 5**. Drive the screws. After the glue dries, glue and clamp the sides (M) in place, as shown in **Photo H**. Drill mounting holes through the top into the sides, and drive the screws.

6 From ¼" plywood, cut the back (P) to size to fit the case opening. For ease of finishing, you'll install the back later.

Add the peg rail

1 From an edge-joined panel, cut the peg rail (Q) to size. Then lay out the cutout with 1½" radiused ends, where dimensioned on **Drawing 7**. Bandsaw and sand the cutout to shape.

2 Mark centerpoints on the peg rail for holes to fit the tenons on your Shaker pegs, where dimensioned on **Drawing 7**. (The tenons on our 3½"-long pegs, which we found at a local home center, measured ½" in diameter and ⅝" long.) Using a Forstner bit in your drill press, bore the holes at the marked centerpoints. Rechuck with a 5/32" twist bit. Centering the bit in the holes, drill shank holes through the rail for securing the pegs with screws later.

3 On the *back* face of the peg rail, countersink the 5/32" holes. Then drill two countersunk shank holes at each end, where shown on **Drawing 7**. Sand the rail smooth. Now glue and clamp the rail in the rabbeted back edges of the sides (M), tight against the fillers (O), drill pilot holes into the sides, and drive the screws. For ease of finishing, you'll install the Shaker pegs later.

GLUE THE CASE TO THE SHELF

Glue and clamp the case to the shelf (R) with the case centered side-to-side and flush at the back.

On to the shelf and cleats

1 From an edge-joined panel, cut the shelf (R) to size. Using a ½" round-over bit in your table-mounted router, round over the ends and then front edge of the shelf on the *bottom* face, where shown on **Drawing 7**. Sand the routed ends and edge smooth.

2 To attach the shelf to the case, cut two 2¼x48" spacers from ¾" scrap. (The spacers provide clearance for clamping.) With the bottom face up, place the shelf on the spacers, as shown in **Photo I**. Apply glue to the case top (K). Now position the case on the shelf, centered side-to-side and flush at the back, and clamp together, as shown.

3 From an edge-joined panel planed to ½" thick, cut the case and wall cleats (S, T) to the sizes listed. (The ½"-shorter wall cleat makes it easy to engage the case cleat when hanging the wall shelf.) Bevel-rip one edge of each cleat at 45°, leaving a ⅛" flat, where shown on **Drawing 7a**. Then drill mounting holes through the *back* face of the case cleat (S), where shown on **Drawing 7**. Set the cleats aside.

Finish up

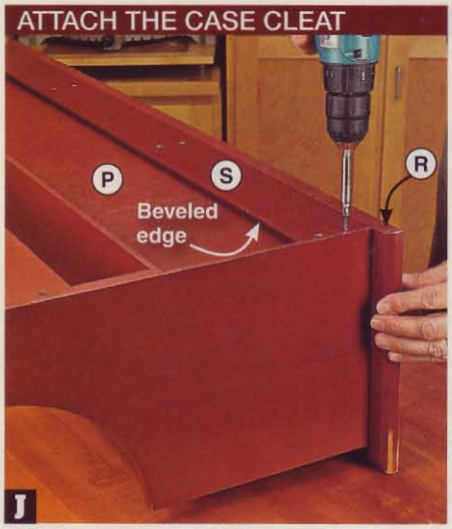
1 Finish-sand any areas that need it to 220 grit, and remove the dust.

2 Apply masking tape around the tenons on the Shaker pegs. Then mask the mating holes in the peg rail (Q). For an easy way to do this, see the **Shop Tip**, *below*.

SHOP TIP

Mask small holes fast with cotton balls

Here's a frustration-free way to mask holes. Simply insert cotton balls in the holes, tamping the balls in place with a pencil eraser, as shown. (For holes larger than 1" in diameter, you can insert several balls.) After finishing, remove the cotton with a small straight-bladed screwdriver, tweezers, or needle-nose pliers.



With the case cleat (S) tight against the shelf (R) in the orientation shown, drill pilot holes into the case and drive the screws.

3 Finish the wall shelf, plywood back (P), case cleat (S), and Shaker pegs as explained for the storage bench in Step 2 of "Finish Up" on *page 57.*

4 Place the back (P) in position and attach it to the case with #18×¾" wire brads, where shown on **Drawing 5**. Then position the case cleat (S) on the back, tight against the shelf (R), where shown on **Drawing 7a** and as shown in **Photo J**. Using the shank holes in the cleat as guides, drill pilot holes into the case. Now drive the screws.

5 Unmask the Shaker pegs and mating holes in the peg rail (Q). Then glue the pegs in the holes. To strengthen the peg attachments, drill pilot holes and drive screws into the pegs, as explained in the **Shop Tip**, *above.*

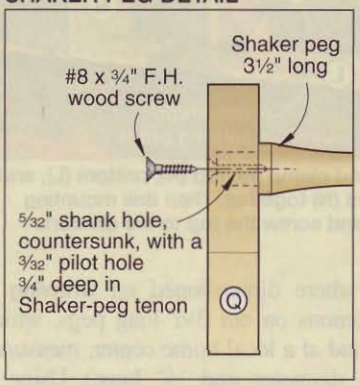
6 Finally, to hang the wall shelf, hold the wall cleat (T) level on your wall with the beveled edge positioned where shown on **Drawing 7a**. Drill countersunk mounting holes through the cleat into the wall studs, and fasten with #8×2½" flathead wood screws. Hang the shelf. Now retrieve your coats, umbrella, hats, and other frequently used items from that overstuffed closet and organize them on the pegs and in the cubbies. For help finding baskets to fit into the cubbies, see **Sources** (for the storage bench) on *page 57.*

SHOP TIP

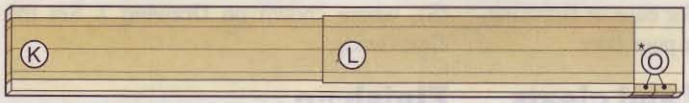
Screw-mount Shaker pegs for added strength in pine

When installing Shaker pegs in projects made from a soft wood, such as white pine, reinforce the peg attachments with screws. This helps to keep the pegs straight when heavy items are hung on them, preventing elongation of the peg holes and loose pegs. After gluing the pegs in the peg rail (Q), for example, drill 3/32" pilot holes ¾" deep, centered in the predrilled shank holes in the rail, into the pegs, where shown on the drawing. Then secure the pegs with #8×¾" flathead wood screws, as shown *below.*

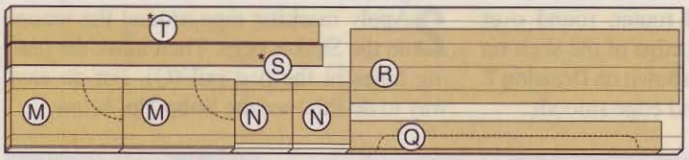
SHAKER PEG DETAIL



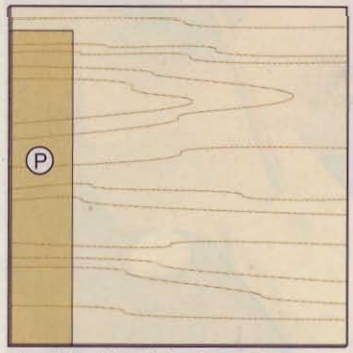
Cutting Diagram



¾ x 12 x 96" Edge-joined pine panel
*Plane to the thickness listed in the Materials List.



¾ x 20 x 96" Edge-joined pine panel



¼ x 48 x 48" Birch plywood

Find an index
to past WOOD magazine articles at
woodmagazine.com/index

Materials List

Wall shelf		FINISHED SIZE T	W	L	Matl.	Qty.
K	top	¾"	8¾"	44½"	EP	1
L	bottom	¾"	9½"	44½"	EP	1
M	sides	¾"	9½"	16"	EP	2
N	dividers	¾"	8¾"	8¼"	EP	2
O	fillers	½"	¾"	3"	EP	2
P	back	¼"	44½"	8¾"	BP	1
Q	peg rail	¾"	4"	44½"	EP	1
R	shelf	¾"	10½"	47"	EP	1
S	case cleat	½"	3"	44½"	EP	1
T	wall cleat	½"	3"	44"	EP	1

Materials key: EP–edge-joined pine panel, BP–birch plywood.
Supplies: #8×1½" flathead wood screws (24); #8×2½" flathead wood screws (3); #8×¾" flathead wood screws (6); 3½"-long Shaker pegs (6), available at your local home center; #18×¾" wire brads.
Blade and bits: Dado-blade set, Forstner bit equal to the diameter of the Shaker-peg tenons, ½" round-over router bit.

Written by **Owen Duvall** with **Chuck Hedlund**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine; Lorna Johnson**

Starting with a blank slate, we created a dream shop with down-to-earth ideas you can apply in your shop.

Welcome to the new WOOD® magazine workshop

The *WOOD* magazine staff faces deadlines every day, but never one like this. After more than 20 years in the same workshop, we pulled up stakes and relocated to a newly designed 1,678-square-foot shop nestled squarely in our company headquarters.

Our new space may be bigger than your home shop, but we had to deal with many of the same challenges you're up against. We had to make smart use of every square inch of space and not omit any essential tools. We worked around structural limitations, such as columns and an L-shaped room. And the shop had to be a good neighbor to surrounding office spaces, meaning no disruptive noises or dust. On top of that, we needed to accommodate the workspace and equipment needs of a 16-member staff building everything from intarsia projects to jigs to large furniture.

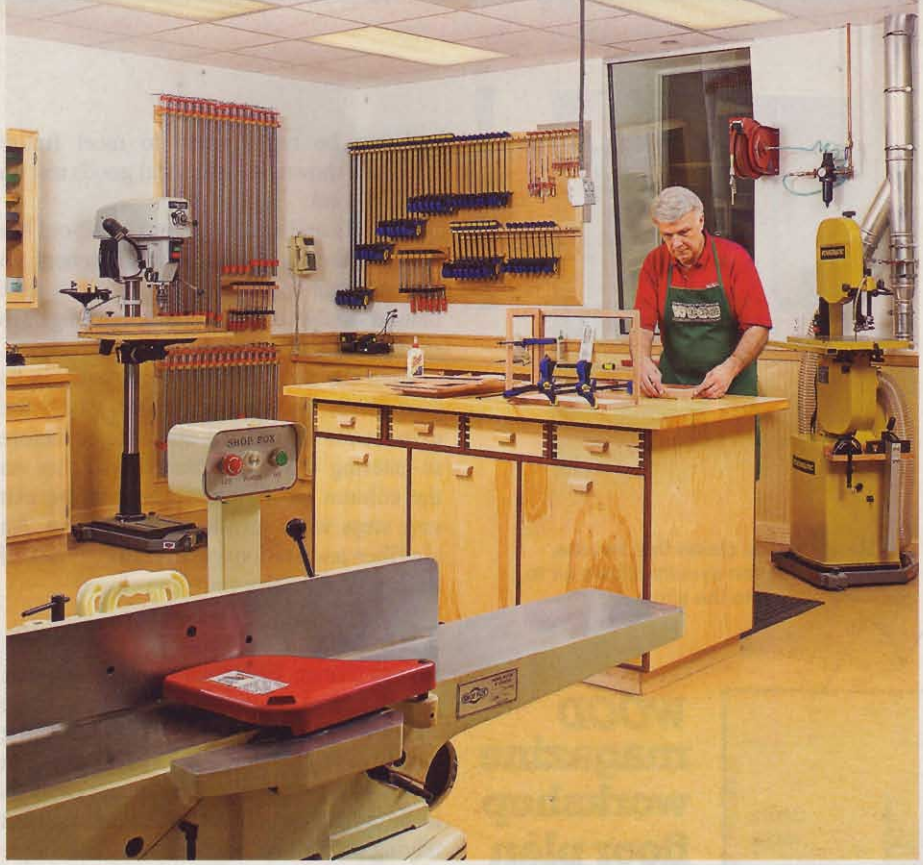
Start with a plan

There was no time to lose before moving day, so design editors Kevin Boyle and Jeff Mertz, together with Master Craftsman Chuck Hedlund, set to work organizing the new space on paper (See the floor plan on *page 64*.) Positioning two of the tablesaws had to come first because each requires about 180 square feet of floor space to include enough infeed and outfeed space to accommodate a 4×8' panel. A third tablesaw equipped with a sliding table, shown *above*, handles only crosscuts.

Next came the anchors of our shop: the three workbenches. While even the heaviest equipment rides on mobile bases for flexible positioning, the benches remain stationary for maximum stability. By placing workbenches near the tablesaws, infeed/outfeed spaces around the saws double as elbow room at the benches, as shown at *right*.

The double-width workbench raises large projects up to eye level for easier assembly.

Other stationary machines occupy the remaining space, but their locations are far from random. The jointer and the two planers are closest to Chuck's bench and a



Chuck Hedlund's work area places many of the tools he uses most frequently in easy reach. An outlet hanging from the ceiling provides power to portable tools. Angled windows, like the one behind Chuck, help keep equipment noise from reaching offices just outside.

Counters store benchtop tools and provide assembly or clamping work space. The clamps sit in customized wood holders.

tablesaw, saving him steps when machining wood to size. Not far away, the drum sander and edge belt sander share each others' buffer zones. The shop designers' layout even included such details as the location of the dust collection ports for each machine and space for stock-support accessories.

They organized Chuck's space to include a drill press and bandsaw, as shown *above*, with another of each standing ready elsewhere in the shop for times when Chuck is joined by other staff members. Anchoring his space is a workbench that, at 38", is 3" higher than the others to suit his height.

Striking a balance

Three tablesaws? Two planers and drill presses? An edge belt sander? True, many woodworkers would feel blessed to have a fraction of our shop's tools, but we chose them for a reason. Each tool earns its keep.

Some tools, such as our SawStop cabinet saw, undergo long-term testing to see how they perform and hold up. Where we have duplicate tools, including the planers shown at *right*, it's because Chuck, Jeff, and Kevin may all be building projects at the same time. Such tools as the edge belt sander save precious time, and there's never enough of that when you're building six or more projects for each issue.

Here's what you won't see: Specialized tools that perform a function you can't duplicate at home with general-purpose tools. An ultra-precise router-lift table, for example, helps us test-build projects quickly, but you can get similar, though slower, results using a shop-made router table without a router lift. Rest assured, any project step we can complete in the *WOOD* magazine shop can be accomplished in your home shop.

A place for everything

Owning the right tool for the job means little if you can't find it, so we put as much thought into storage as into machine layout. Because of their depth, cabinets store more than perforated hardboard would for the amount of wall space covered. So that's where we store all of our hand tools, portable power tools, bits, hardware, and accessories.

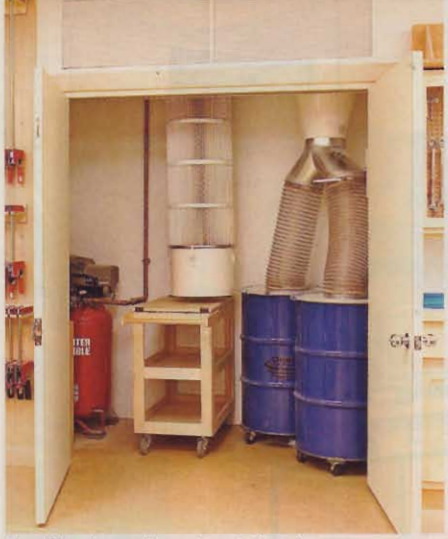
Wherever possible, we store accessories next to the equipment that uses them. Even an obstacle—a 27×29" column in the center of the workspace—became a storage opportunity, with shallow cabinets on two sides.

Clamp storage fills the remaining wall space to put them within easy reach without intruding over the counter space, as shown *above*. Altogether, the shop stores more than 375 clamps.

Lumber has its own storage area: a wall of wire shelves that don't accumulate dust, allow air to reach both sides of the wood,

Each of the stationary tools feeds dust into the collection system, including the radial-arm saw with a wall-mounted chute. The system's floor sweep is shown to the right.

Wire shelves keep lumber flat and out of the way. Panels ride on a cart that's easy to relocate as space needs change.



A grille above the closet that houses the dust-collection system allows air to circulate back into the shop.

and can be repositioned to meet future needs, as shown *far left*. Sheet goods rest on a rolling rack.

Cut-offs and scraps go into a roll-out bin beneath the radial-arm saw. Fasteners go into pull-out metal bins stacked in a rack behind double cabinet doors. And jigs are stored atop cabinets beneath the 9' ceiling.

Even the dust collector tucks away in its own closet, shown at *near left*, where the exhaust air is muffled and filtered before re-entering the shop. Remote switches on the column by the planers and at the exit save steps when turning on the system. An air filter and stationary air compressor fill the rest of the noise-muffling closet.

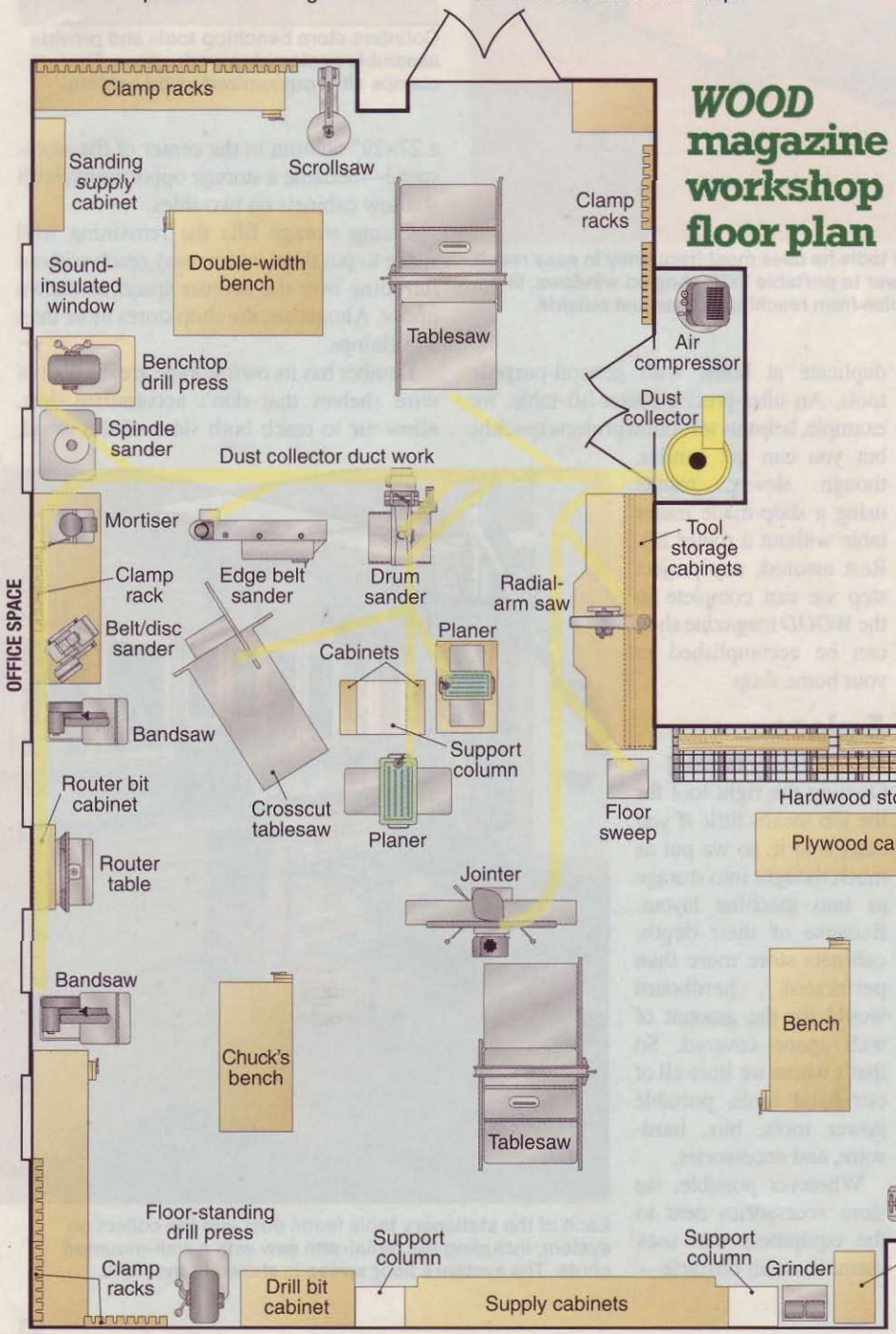
The next 20 years

Things change. Equipment comes and goes, and the shop is designed to handle those changes. For example, sound-deadening walls, with plywood sandwiched between sheets of drywall, allow racks and cabinets to be added or moved as needed without relying on wall anchors or studs. The ample fluorescent lights can be repositioned in the suspended ceiling, and even the rigid ducts of the dust collection system connect to flexible hoses, so equipment can be repositioned or replaced as needed.

To make sure we'll always be welcome inside the Meredith corporate offices, our soundproofing puts the "shhhh" in shop. Blown-in insulation fills the spaces behind our triple-thick walls. Standard acoustical tiles form the ceiling, and linoleum covers the concrete floors to deaden sounds and cushion our legs and feet. Even the windows help deflect and deaden sound. The result: Ringing office phones outside the shop make more noise than the loudest equipment heard from outside the shop.

Not even dust escapes. Air cleaners above the ceiling trap sawdust not caught by the dust collectors. The shop even has its own heating and air-conditioning systems to prevent dust from reaching surrounding offices.

Above all, our new shop serves our readers. Whatever the project or technique, we're prepared to give it our "shop tested" designation for decades to come.



TOOL LIST

Curious about which tools we chose for our own shop? We're always changing products to test the newest models, but here's the starting lineup.

Stationary Power Tools

3-hp cabinet saws: **Delta** Unisaw, **General** 650; **SawStop** CB31230
Jointer: **Shop Fox** W1705 8"
Planers: **Delta** 50-785 15", **DeWalt** DW635 13"
Drill presses: **Delta** 17-968 17" variable-speed, **Powermatic** PM2800
Bandsaws: **Powermatic** PWBS-14 14", **Rikon** 10-340 18"
Router table: **JessEm** MastRLift Excel with **Porter-Cable** 7518 router motor
Sanders: **Grizzly** G0564 edge belt sander, **Jet** 16-32 Plus drum sander, **Shop Fox** W1686 oscillating spindle sander
Scrollsaw: **DeWalt** DW788
Lathe: **Jet** JWL1442
Air compressor: **Porter-Cable** CPFC2TV-3525VP 25-gallon two-stage
Radial-arm saw: **Craftsman** 96320 10" (discontinued)

Portable Power Tools

Sanders: **Fein** FSS 12-27E 8" sander/polisher, **Porter-Cable** 333VS random-orbit, **DeWalt** D26453 random-orbit, **Ridgid** R2720 belt, **Ridgid** R2500 quarter-sheet
Cordless drills: **Porter-Cable** 9966; **DeWalt** DC980KA; **Festool** TDK 12CE set, C12; **Fein** ABS-14; **Bosch** 32614
Routers: **Porter-Cable** 690 fixed base, **Makita** RF1101 multi-base kit, **DeWalt** DW621 plunge, **Ridgid** R2930 multi-base kit, **Bosch** Colt trim, **Ryobi** P600 laminate trimmer, **Porter-Cable** 2902 19.2-volt cordless
Biscuit joiner: **Porter-Cable** 557
Jigsaws: **Freud** FJ85, **Bosch** 1584DVS
Plunge-cut circular saw: **Festool** TS55
Nailer: **Ridgid** R213BNA brad

Benchtop Power Tools

Mortising machine: **Powermatic** 701
Belt/disc sander: **Grizzly** G1013

Dust Collection

Dust collector: **Oneida** 5-hp cyclone, ductwork, and system design
Vacuums: **Fein** Turbo III Dust Extractor, **Festool** Dust Extractor CT Mini

Miscellaneous

Clamps: **Adjustable Clamp** (Jorgensen Cabinet Master aluminum bar clamps, ISD bar clamps, Pony ISD hand clamps); **Bessey** K-Body, KliKlamps, light-duty bar clamps; **Jet** parallel clamps
Radial-arm saw fence: **Kreg Tool** Precision Measuring Systems Heavy Duty Trak
Drill bits: **Bosch** T14029 29-piece set

PHOTO/VIDEO SHOP

Wall paneling: **Gulf States Paper** 1×6" V-groove southern yellow pine
Floor: **Trout River Lumber** 1×4" prefinished southern yellow pine
Vacuum: **Beam** Serenity Plus 2775

In addition to the main shop, we shoot photos and video in this shop. Southern yellow pine floors and walls provide a pleasing backdrop.

SUPPLIERS

Adjustable Clamp (Jorgensen, Pony)
312/666-0640, adjustableclamp.com
Beam
515/832-4620, beamvac.com
Bessey
800/828-1004, besseyclamps.com
Bosch
877/267-2499, boschtools.com
Craftsman
800/349-4358, sears.com
Delta
800/223-7278, deltamachinery.com
DeWalt
800/433-9258, dewalt.com
Fein
800/441-9878, feinus.com
Festool
888/337-8600, festoolusa.com
Freud
800/334-4107, freudtools.com
General
819/472-1161, general.ca
Grizzly Industrial
800/523-4777, grizzly.com
Gulf States Paper, Wood Products Division
205/562-5800, gulf-states.com
JessEm
866/272-7492, jessem.com
Jet
888/804-7129, jettools.com
Kreg Tool
800/447-8638, kregtool.com
Makita
800/462-5482, makitatools.com
Oneida
800/732-4065, oneida-air.com
Porter-Cable
888/848-5175, porter-cable.com
Powermatic
888/804-7129, powermatic.com
Ridgid
800/474-3443, ridgid.com
Rikon
877/884-5167, rikontools.com
Ryobi
800/525-2579, ryobitools.com
SawStop
866/729-7867, sawstop.com
Shop Fox
800/840-8420, shopfox.biz
Trout River Lumber
804/744-7771, troutriverlumber.com

From our shop to yours: Lessons learned

Shop designer Jeff Mertz wouldn't change anything about *WOOD* magazine's finished shop. That's the benefit of analyzing and modifying your shop design on paper instead of after construction starts. During this planning process, Jeff and the rest of the staff discovered some shop design secrets you can use:

■ ***Ask for advice.*** Not once, but several times, Jeff reviewed his designs with Chuck Hedlund and other staff members before finalizing the design. When laying out your shop, seek input from veteran woodworking friends. They'll be pleased to help you avoid the errors they discovered the hard way.

■ ***Mobility = flexibility.*** By placing stationary tools onto mobile bases, we can fine-tune their locations, move them for easy clean-up, and relocate them to accommodate new or additional equipment.

■ ***Bright is better.*** Our shop uses roughly four times the overhead lighting found in the surrounding office areas. White walls and ceiling tiles reflect and diffuse the shop light. Even the light maple cabinetry was chosen for its light-reflecting qualities.

■ ***Light right.*** Think about where your equipment will be located, and then position light fixtures accordingly. If you add lights in a fixed pattern instead of where they're needed, you could find your benchtop darkened by your own shadow.

■ ***Add 220-volt outlets.*** Hire an electrician to install 220-volt outlets for power-hungry tools such as cabinet saws and jointers. Even if you don't have these tools today, adding outlets before the drywall goes up makes it easier to add step-up tools in the future.

■ ***Make cleanup easy.*** The *WOOD* magazine shop has three compressed-air hose reels for knocking the dust off tools and project parts, plus a floor sweep intake tied to the dust collector.

shelves with a fresh slant

Enjoy a clear view of cherished collectibles, books, and plants on this open-sided, step-styled display rack.

Looking for an easy-to-build project that will show off your treasured items and craftsmanship? Try this one. You can complete it in just a few evenings or a weekend, thanks to the simple biscuit-joined sides and straightforward dado- and rabbet-joined shelf assemblies.

Start with the sides

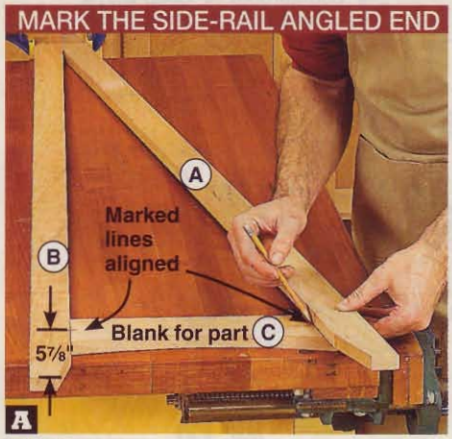
1 From ¾"-thick stock (we used cherry), cut two 2×70" blanks to form the front legs (A), and cut the two back legs (B) to the size listed in the **Materials List**. On the *outside* face of a front-leg blank, lay out the angled ends and edges, where dimensioned on **Drawing 1**, noting the 69¾" finished length. Then lay out the angled edge on the *outside* face of a rear leg, where dimensioned on **Drawing 2**.

2 To form matching angled legs for identical assembly of the sides, pair and adhere the *inside* faces of the front-leg blanks and back legs together with cloth-backed, double-faced tape. Then miter-cut the 12° *ends* on the front-leg blanks along the marked lines using your mitersaw or tablesaw with an extension on the miter gauge. Now form the 12° *edges* on the front and back legs, as explained in the sidebar, *opposite page, bottom*. Separate the legs and remove the tape, using paint thinner, if needed, to soften the adhesive.

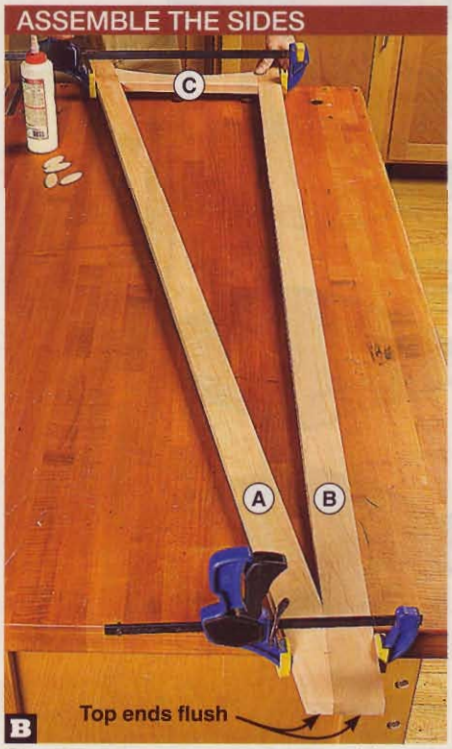
3 From ¾"-thick stock, cut two 3¼×13" blanks for the side rails (C) and cut the stretcher (D) to the size listed.

4 To trim the side rails (C) to the finished length, draw centerlines at the ends of a rail blank on the *outside* face. Also draw alignment lines on the *outside* faces of a front and back leg (A, B) 5⅞" from the bottom ends, where dimensioned on **Drawing 2**.

Next, dry-assemble the legs in the configuration shown on **Drawing 3** on *page 68* with the top ends flush and clamped together. Then position the rail blank between the legs with the marked lines aligned and the front leg overlapping the blank. Now mark the angled front end of the blank, as shown in **Photo A**.



With the front leg (A) resting on the side-rail blank (C), draw a line along the leg back edge to mark the angle on the rail blank.



Glue, biscuit, and clamp a front leg (A), back leg (B), and side rail (C) together to form each side, keeping the leg top ends flush.

5 To form identical side rails (C), adhere the *inside* faces of the blanks together with cloth-backed, double-faced tape. Using your tablesaw or mitersaw, miter-cut the ends of the blanks at the marked line. (After miter-cutting, our rails measured 12½" long.) Do not separate the rails.

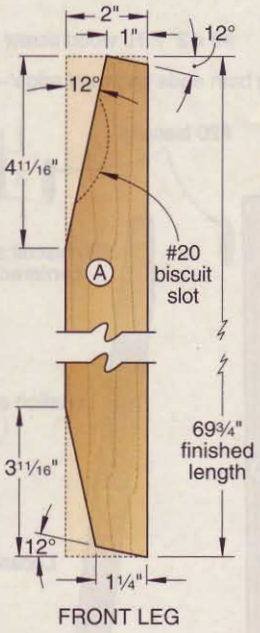
6 Mark the centers of the arches on the side rails (C) and stretcher (D), where dimensioned on **Drawing 3**. Draw the arches using a fairing stick. (For a free fairing stick plan, go to woodmagazine.com/fairing.) Bandsaw and sand the arches to shape. Then separate the side rails, and remove the tape.

7 Draw centerlines for #20 biscuit slots on the front and back legs (A, B), side rails (C), and stretcher (D), where dimensioned on **Drawings 2** and **3**. Plunge the slots in the parts, centered in the ¾" thickness. Now glue, biscuit, and assemble the legs and side rails, as shown in **Photo B**. Sand the assemblies smooth. Set the stretcher (D) aside.

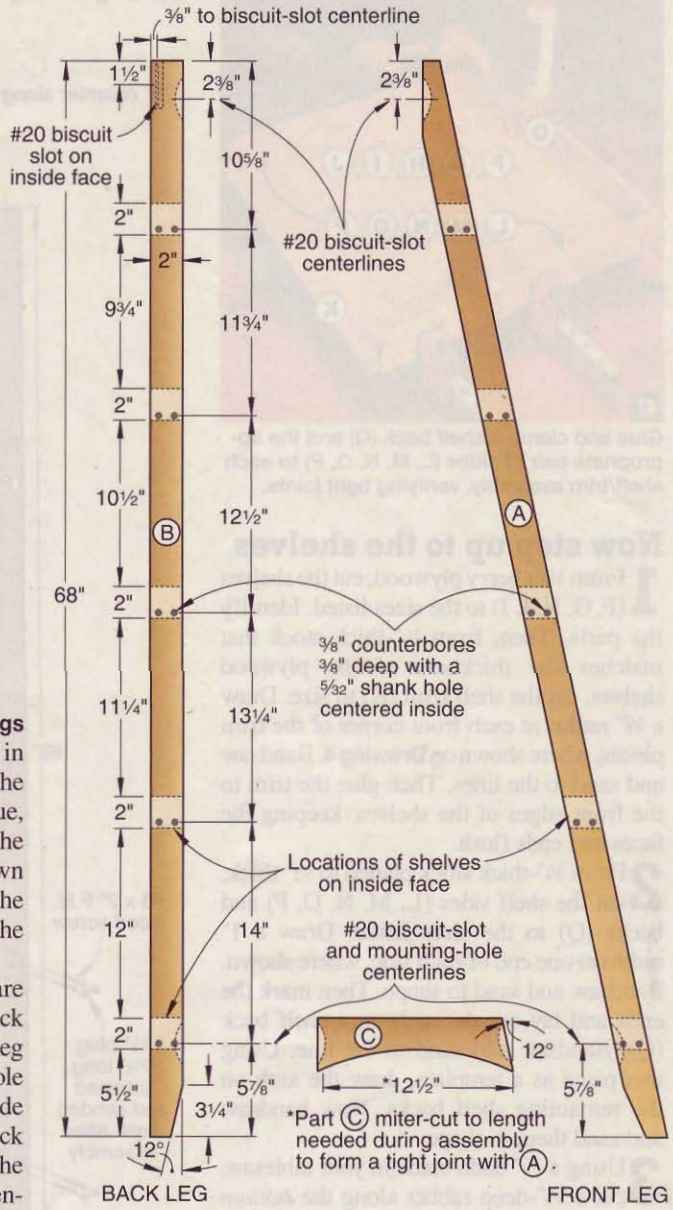
8 Using a framing square aligned with the back edge of each back leg (B), mark mounting-hole centerpoints on the outside faces of the front and back legs (A, B) for attaching the five shelves, where dimensioned on **Drawing 2**.

9 From ¾"-thick stock, cut the top (E) to the size listed. Using a 45° chamfer bit in your router, rout a ⅜" chamfer along the ends and then the front edge of the top on the *bottom* face, where shown on **Drawing 3**. Sand the top (E) smooth, and set it aside.

1 PART VIEW



2 SIDE VIEW (Outside face of left side shown)



An easy way to form the angled leg edges

To cut the 12° edges (not ends) on the front and back legs (A, B) using your tablesaw or mitersaw, you'd need to build a sled or jig to position and securely hold the legs. Here's a simple way to do it without making a special fixture. With the leg pairs joined together with double-faced tape, bandsaw or jigsaw the edges close to the marked lines. Then, with the legs clamped to your workbench and using a block plane adjusted for light shavings, shave the edges flush to the lines, as shown. (A 120-grit sanding block also works well.) Check with a square that the edges are 90° to the faces. This will ensure a tight and flush joint between the front and back legs at the top.

Glue and clamp a shelf back (Q) and the appropriate pair of sides (L, M, N, O, P) to each shelf/trim assembly, verifying tight joints.

Now step up to the shelves

1 From ¾" cherry plywood, cut the shelves (F, G, H, I, J) to the sizes listed. Identify the parts. Then, from ¾"-thick stock that *matches the thickness of the plywood* shelves, cut the shelf trim (K) to size. Draw a ⅜" radius at each front corner of the trim pieces, where shown on **Drawing 4**. Bandsaw and sand to the lines. Then glue the trim to the front edges of the shelves, keeping the faces and ends flush.

2 From ¾"-thick stock planed to ½" thick, cut the shelf sides (L, M, N, O, P) and backs (Q) to the sizes listed. Draw a 1" radius at one end of each side, where shown. Bandsaw and sand to shape. Then mark the ends and lay out the arch on a shelf back (Q). Bandsaw and sand to the line. Using this piece as a template, draw the arch on the remaining shelf backs. Now bandsaw and sand them to shape.

3 Using a ¾" dado blade in your tablesaw, cut a ¼"-deep rabbet along the *bottom* edges of the shelf sides (L, M, N, O, P) and backs (Q) on the *inside* faces, where shown. Switch to a ½" dado blade. Then cut a ¼"-deep rabbet across the *back* end of the shelf sides on the *inside* faces.

4 Match up each shelf/trim assembly (F/K, G/K, H/K, I/K, J/K) with the appropriate pair of sides (L, M, N, O, P) and a back (Q), where shown on **Drawing 3**. Dry-assemble the parts, and check for correct fit. Also, verify that the length of each assembly (including the sides) measures 20", matching the 20"-long stretcher (D) to ensure parallel assembly of the unit. Make any needed adjustments. Then apply glue in the rabbets in the sides and back, and clamp each shelf together, as shown in **Photo C**.

Put it all together

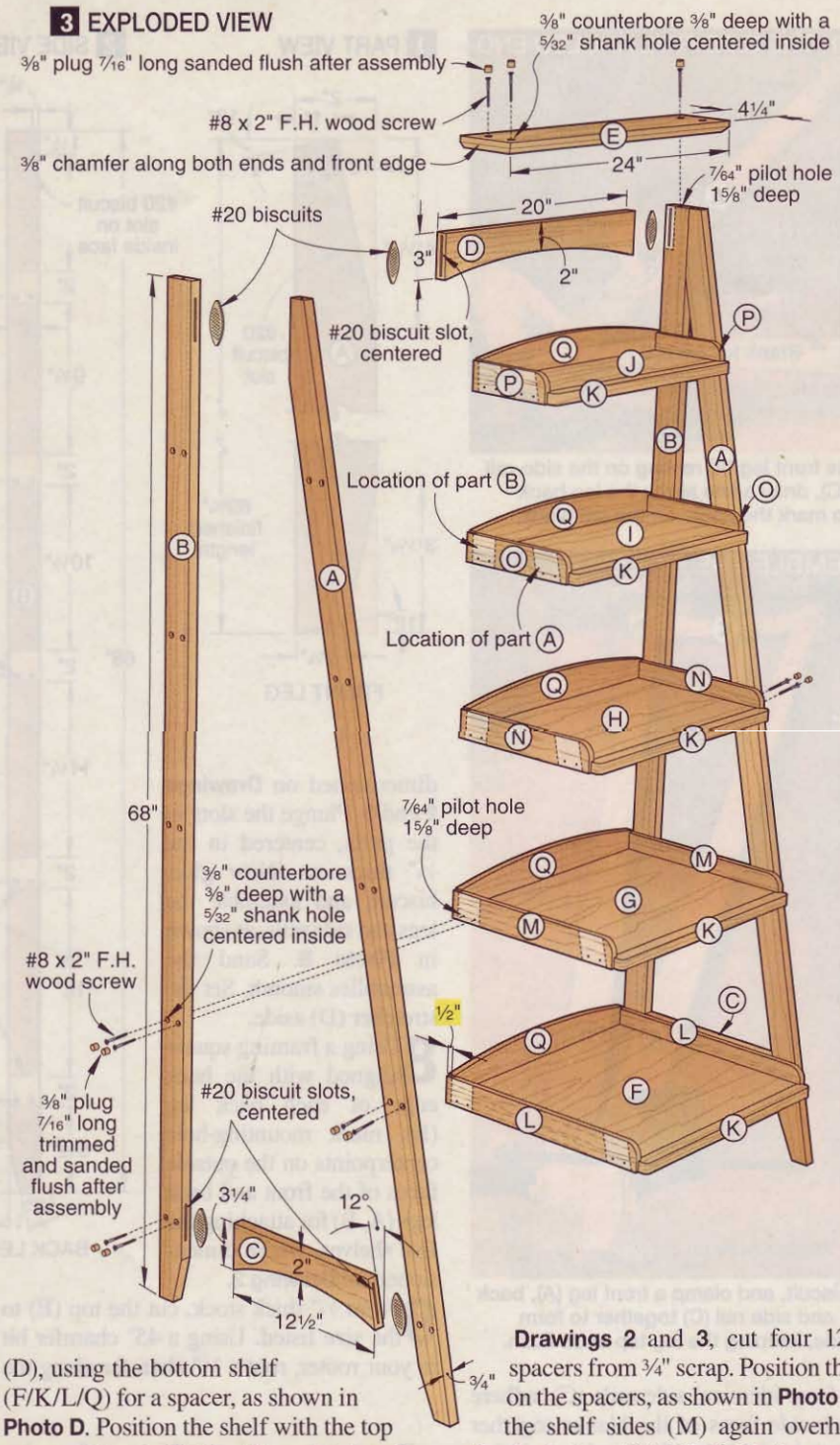
1 On a flat surface, glue, biscuit, and clamp together the sides (A/B/C) and stretcher (D), using the bottom shelf (F/K/L/Q) for a spacer, as shown in **Photo D**. Position the shelf with the top edges of the shelf sides (L) and side rails (C) flush and the shelf sides overhanging the back legs (B) ½", where dimensioned on **Drawing 3**. Clamp the shelf to the side rails. Using a square, verify the shelf is 90° to the back legs.

2 With the bottom shelf (F/K/L/Q) still clamped in place, position the assembly upright on a flat worksurface. Then drill counterbored mounting holes at the marked centerpoints for the bottom shelf through the legs and into the shelf, as shown in **Photo E**. Drive the #8×2" flathead wood screws.

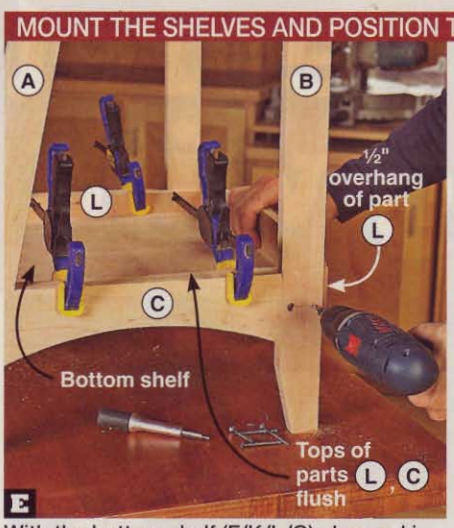
3 To install the second shelf (G/K/M/Q) in the assembly, where dimensioned on **Drawings 2** and **3**, cut four 12"-long spacers from ¾" scrap. Position the shelf on the spacers, as shown in **Photo F**, with the shelf sides (M) again overhanging the back legs (B) ½". Drill the mounting holes, and drive the screws.

4 Crosscut the spacers to 11¼" long. Then, in the same way, position and secure the third shelf (H/K/N/Q) on the spacers. Now trim the spacers to lengths of 10½" and 9¾" to install the remaining shelves (I/K/O/Q) and (J/K/P/Q).

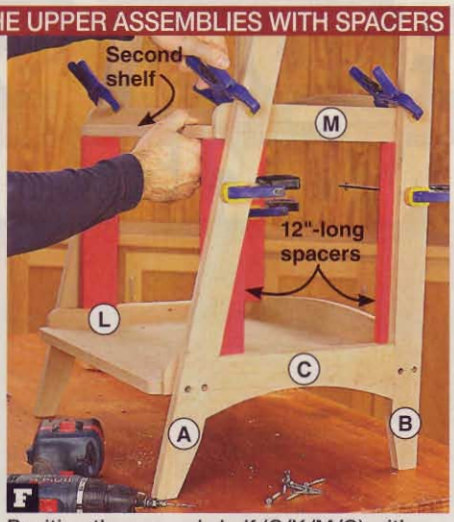
5 Position the top (E) on the assembly, centered side-to-side and flush with the back face of the stretcher (D). Drill counterbored mounting holes through the top and into the front and back legs (A, B), where shown on **Drawing 3**. Drive the #8×2" flathead wood screws.



Glue, biscuit, and clamp together the sides (A/B/C) and stretcher (D), using the bottom shelf (F/K/L/Q) to square the assembly.



With the bottom shelf (F/K/L/Q) clamped in position, drill counterbored mounting holes through the legs (A, B) into the shelf.



Position the second shelf (G/K/M/Q) with 12"-long spacers set on top of the sides (L) of the first shelf. Clamp the shelf to the legs.

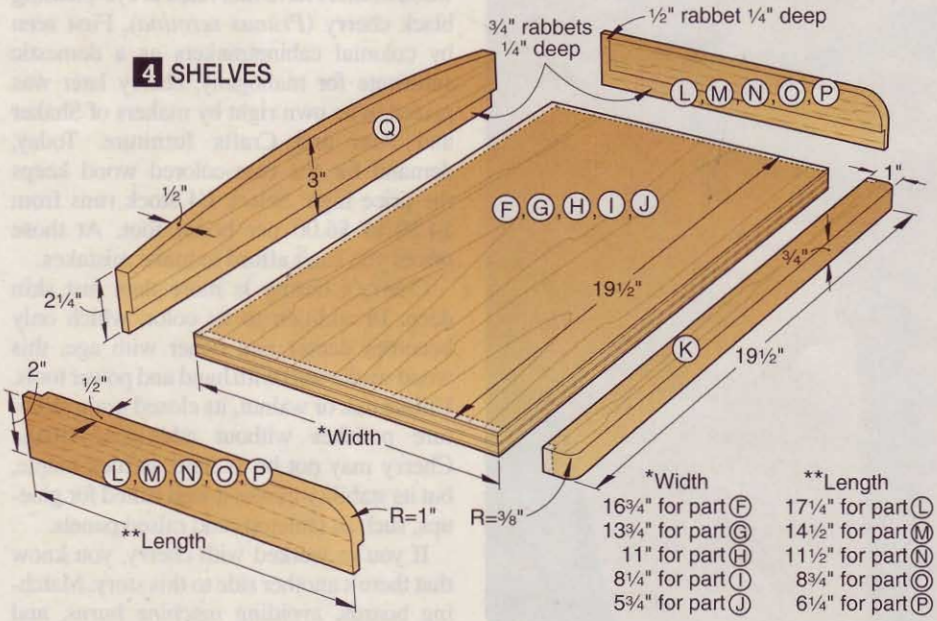
Finish up

1 Using a ⅜" tapered plug cutter in your drill press, make ten 7/16"-long plugs for each front and back leg (A, B) and four plugs for the top (E) from your ¾"-thick cutoffs, selecting areas that match the color and grain of the parts. (We made 50 plugs, allowing six extra in case of damage.) Glue the plugs in the ⅜" counterbores in the parts with the grain patterns aligned. Let the glue dry overnight. Then, using a flush-trim saw, trim the plugs. (Lay card stock on the surface for protection if you don't have a flush-trim saw.) Now sand the plugs flush.

2 Sand any areas that need it to 220 grit, and remove the dust. Then apply a clear finish. (We applied three coats of satin Varathane Diamond Wood Finish, sanding to 320 grit between coats.)

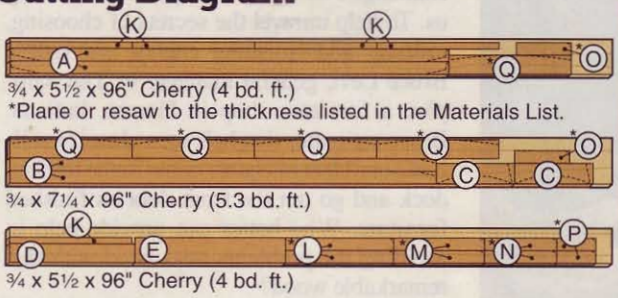
3 Finally, place the shelving unit where desired. Then round up some special photos, books, plants, and other items, set them on the shelves, and step back and admire your handiwork.

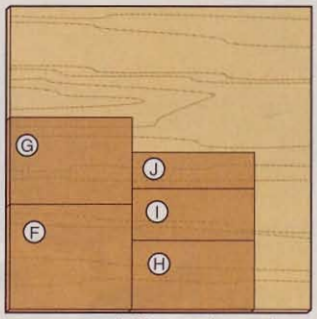
Written by **Owen Duvall** with **Kevin Boyle**
Project design: **Jeff Mertz**
Illustrations: **Roxanne LeMoine; Lorna Johnson**



*Width	**Length
16¾" for part F	17¼" for part L
13¾" for part G	14½" for part M
11" for part H	11½" for part N
8¼" for part I	8¾" for part O
5¾" for part J	6¼" for part P

Cutting Diagram





¾ x 48 x 48" Cherry plywood

Materials List

Part		FINISHED SIZE T	W	L	Matl.	Qty.
A*	front legs	¾"	2"	69¾"	C	2
B	back legs	¾"	2"	68"	C	2
C*	side rails	¾"	3¼"	12½"	C	2
D	stretcher	¾"	3"	20"	C	1
E	top	¾"	4¼"	24"	C	1
F	shelf	¾"	16¾"	19½"	CP	1
G	shelf	¾"	13¾"	19½"	CP	1
H	shelf	¾"	11"	19½"	CP	1
I	shelf	¾"	8¼"	19½"	CP	1
J	shelf	¾"	5¾"	19½"	CP	1
K	shelf trim	¾"	1"	19½"	C	5
L	shelf sides	½"	2"	17¼"	C	2
M	shelf sides	½"	2"	14½"	C	2
N	shelf sides	½"	2"	11½"	C	2
O	shelf sides	½"	2"	8¾"	C	2
P	shelf sides	½"	2"	6¼"	C	2
Q	shelf backs	½"	3"	19½"	C	5

*Parts initially cut oversize. See the instructions.
Materials key: C–cherry, CP–cherry plywood.
Supplies: Cloth-backed, double-faced tape; #20 biscuits (8); #8x2" flathead wood screws (44).
Blade and bits: Dado-blade set, ⅜" tapered plug cutter, 45° chamfer router bit.

A pro's secrets for working with cherry

Wood movement, darkening, grain defects—it seems that lots can go wrong when building projects from cherry. Hopefully, the remedies found here will help you control them all!

Master Woodworker Bruce Levi shares 31 years of shop experience to help you get the most from the Cadillac of cabinet woods.

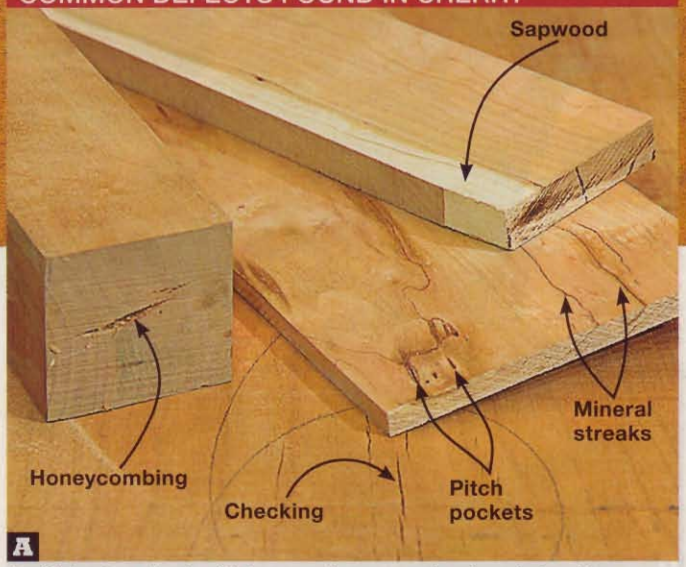
Having used nothing but cherry for three decades, Bruce Levi doesn't run into many surprises when working with this temperamental wood, although he still finds himself stopped by its natural beauty.

For more than 200 years, American woodworkers have marveled at eye-pleasing black cherry (*Prunus serotina*). First seen by colonial cabinetmakers as a domestic substitute for mahogany, cherry later was prized in its own right by makers of Shaker and Arts and Crafts furniture. Today, demand for the rose-colored wood keeps the price high. Select 4/4 stock runs from $4.50 to $6.00 per board foot. At those prices you can't afford to make mistakes.

Cherry's beauty is more than just skin deep. In addition to its color, which only becomes darker and richer with age, this wood works well with hand and power tools. Unlike oak or walnut, its closed grain structure polishes without additional fillers. Cherry may not be as hard as rock maple, but its stability makes it well suited for glue-ups, such as tabletops and raised panels.

If you've worked with cherry, you know that there's another side to this story. Matching boards, avoiding machine burns, and preventing blotches when finishing can challenge even the most experienced among us. To help unravel the secrets of choosing, milling, and finishing cherry, we visited Bruce Levi, general manager of The Sampler, a furniture shop in Homer, Indiana. Bruce estimates that he's seen almost a million board feet of cherry come in the loading dock and go out the front door as finished furniture. Who better can provide help in avoiding the problems associated with this remarkable wood?

COMMON DEFECTS FOUND IN CHERRY



Avoid buying stock with too much sapwood, mineral streaking, or pitch pockets. Otherwise good wood can develop bad checks and honeycomb cracks if it is kiln-dried too quickly.

SORTING CHERRY LOGS BY QUALITY

Photo: Joe Hurst-Wajszczuk

Greg Koontz inspects a stack of selectively harvested cherry logs. Large-diameter logs are rare because cherry often falls prey to insects and diseases. A tree's average life span is only 20 years.

Choosing good wood

"The simplest way to avoid milling and finishing problems and reduce waste is to start with good wood," Bruce says. He explains that stock selection is more than just picking out the best-looking boards "There are defects you can see, and some you can't," he says, (see **Photo A**). "Some of my best 'deals' turned out to be less than expected when the wood started checking weeks or months later," Bruce says. To find straight, sound cherry, it helps to know details, such as where the tree grew and how the boards were kiln-dried. The best way to do this is to ask a knowledgeable timber buyer like Greg Koontz from the Foley Hardwoods mill in nearby Bargersville, Indiana.

"Pennsylvania may have cornered the cherry market, but good local wood can be found from Canada all the way down to Florida," Greg says. "Cherry grows anywhere land is allowed to return to a forested state, such as after logging, farming, or forest fires," he adds. Greg explains that log selection involves more than finding the logs, but in learning how and where the trees grew (**Photo B**).

Spotting defects

Technically, sapwood isn't a defect, but long, wide streaks of white wood can be distracting unless you plan to work the contrast into your design. (Unlike heartwood, sapwood will not darken over time.) Bruce tries to use these boards where they won't show. Greg keeps sapwood to a minimum by selecting logs before they're sawn. "Slow-growing trees seem to have less sapwood," Greg says. "Those growing under a canopy of other species are best, but this also means that you won't find a bunch in one spot."

Pitch pockets and mineral streaks (**Photo A**) are "tolerable" defects because they're mostly cosmetic, but these stains can create distracting patches or stripes in an otherwise unblemished cherry panel. According to Greg, the blame belongs not to the tree, but to the local topography.

"The fact is, River bottom cherry is much more likely to absorb minerals that can cause problems," he says. By comparison, "hillside trees," those that grow on gently sloped well-drained soil, produce the clearest stock.

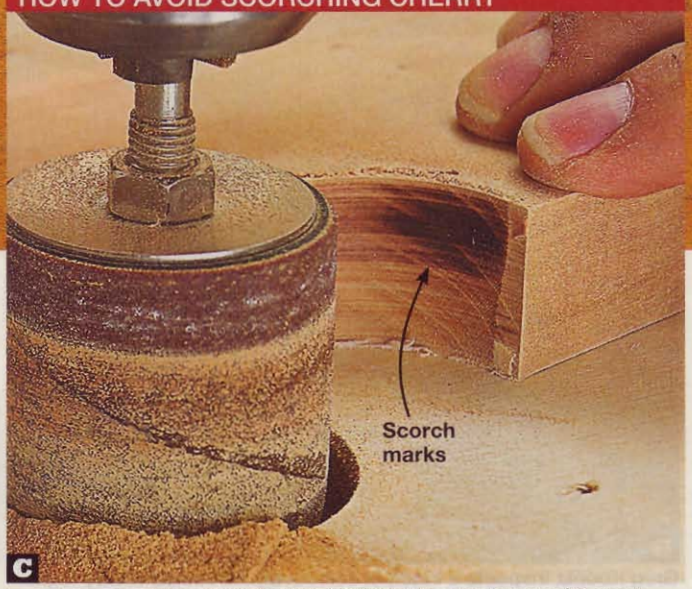
Until it's dry, cherry needs special handling to prevent checking and honeycombing, cracks that run through the end or face grain of the wood. "Cherry takes time to dry, about 21 days in the kiln to get down to 6 to 8 percent moisture content (MC). That's almost twice as long as poplar," Greg says. Because cherry trees aren't as plentiful as other woods, it's not uncommon to have less than a full load for the kiln. "When a mill tries to squeeze in a small load of cherry with another wood or speed up the drying process, you'll run into problems." According to Greg, some of these defects, such as checks, are easy to see, but warns that other negative effects of improper drying, such as honeycombing and case hardening (straight boards that warp when you make your first cut), are hard to determine until you've brought the boards into your shop. "That's why it makes sense to buy from a dealer who knows that it takes time to dry cherry," he says.

"...it makes sense to buy from a dealer who knows that it takes time to dry cherry."

That said, not much time can elapse from when cherry trees are cut into logs, milled into boards, and then kiln-dried. The reason: Wet cherry wood proves tasty to bugs and bacteria. And while air-drying sawn stock may prevent some kiln-related problems, it takes years instead of days to air-dry cherry. Even then, the resulting stock may never achieve furniture-quality MC levels. Nor does air-drying kill off wood-eating organisms hidden within.

These two pieces are but a small sample of The Sampler's traditionally styled collection of cherry furniture.

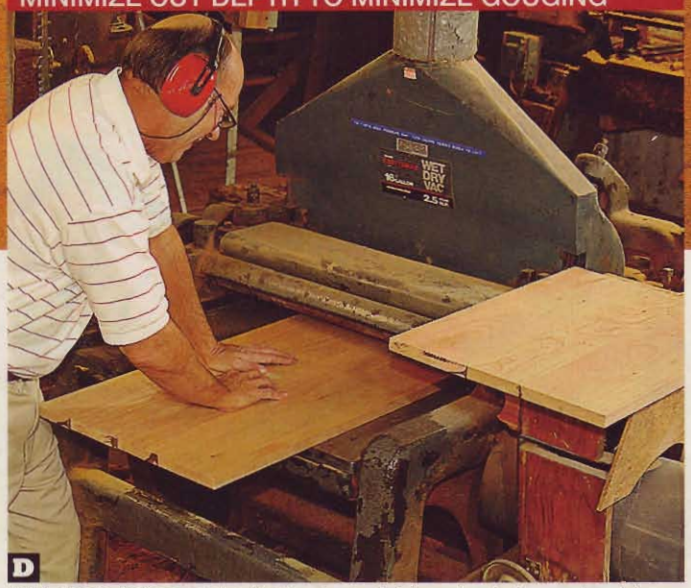
HOW TO AVOID SCORCHING CHERRY



C

No doubt about it: cherry burns. Reduce this tendency with sharp bits and blades. Also, clean or replace any sanding drums, belts, and discs that load up.

MINIMIZE CUT DEPTH TO MINIMIZE GOUGING



D

With sharp knives and a light cut, straight-grained cherry should plane smoothly, regardless of grain direction. Hone or change the blades at the first sign of dulling or gouging.

Machining cherry: the scorch- and chip-free way

The main challenges when working with cherry date to the time when woodworkers switched from hand to power tools. Power-tool users quickly discovered that the resin that helps transform the white sapwood into red heartwood also makes cherry quick to burn or scorch whenever a bit, blade, or bearing lingers in one spot for too long. Even sanding with fine-grit sandpaper can burn cherry. "Everybody gets some scorching. The trick is to minimize it when you can, and sand it out when you can't," Bruce says (**Photo C**). The other problem, grain tear-out, typically occurs when working with wild figure. But, Bruce says, "salvaging that special board isn't necessarily difficult, just different."

At The Sampler, most edge profiles are cut with massive, slower-spinning shaper cutters. But for custom operations that involve router work, Bruce insists that the bits be clean and sharp. "Light passes are key. Don't remove any more than ⅛" with each pass. You don't want the router to stop, or even stall, in mid-stroke. The extra care you is spend here is worth it," he says.

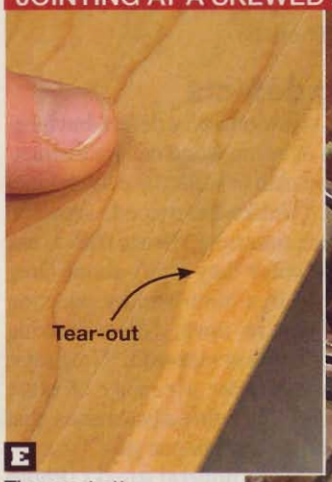
"Everybody gets some scorching. The trick is to minimize it when you can and sand it out when you can't."

You might think that multiple passes would take longer, but Bruce has found that planing and routing cherry in lighter steps saves time and stock. "The few extra seconds it takes to run a board through a machine is nothing compared to the time it takes to sand off a bad burn," he says. Bruce points out that deep burns can ruin a piece completely. If you try sanding or cutting off the damaged area and the piece becomes smaller than the other matching parts, you'll need to replace it.

When forming glue-ups, he turns to the planer to speed up production time. Instead of expending elbow grease by hand-scraping or sanding the uneven edges on the face of glued-up panels, Bruce uses his planer to flatten and smooth wide panels in one light pass. When cleaning up stock, and to prevent burning, he feeds a few boards against the grain without tear-out (**Photo D**). "With light cuts, cherry planes well, regardless of how the board or glue-up panel is fed into the machine," he says.

Bruce saves the wildest, swirliest stock for rails, drawer fronts and other "attention-getting" parts. The problem with this figured stock is that jointers and planers tend to tear out chunks of wood wherever the grain abruptly changes direction, as shown in **Photo E**. To prevent tear-out, Bruce suggests angling the wood so the blade edges contact the board at an angle instead of straight on (**Photo F**). "Skewing the stock doesn't take more time, but of course you couldn't do it with a wide panel," Bruce says.

JOINTING AT A SKEWED ANGLE PREVENTS TEAR-OUT



E

The most attractive boards are the toughest to tame. Here, the jointer took out a chunk of wood right where the grain reversed direction.

F

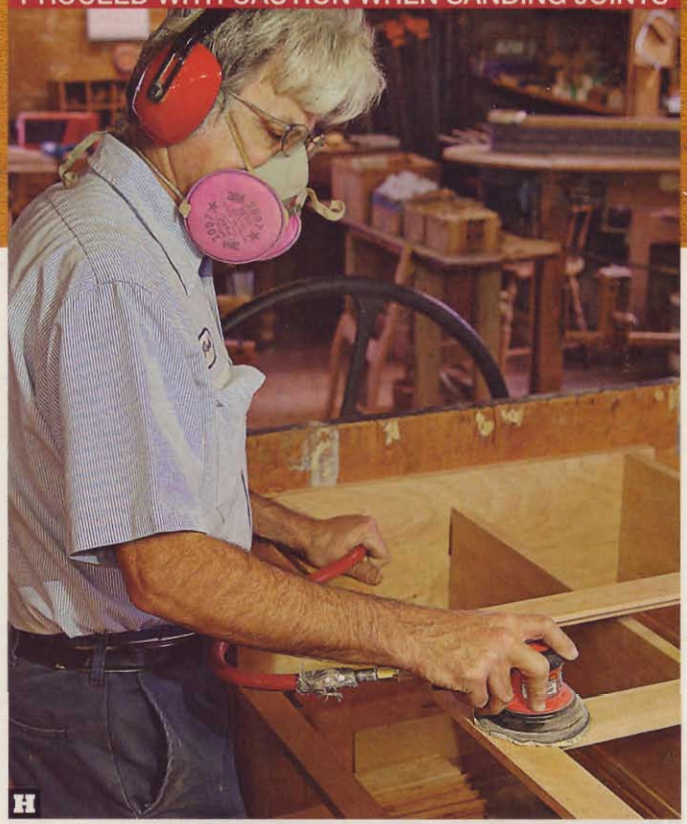
Angling the board as you feed it over the cutterhead reduces the knives' cutting angle, helping them to slice more smoothly.

CUT CABINET DOORS LARGE, AND TRIM TO FIT

G

The hutch doors were purposely cut larger than the opening. Trimming down the doors takes time, but it's easier and quicker than correcting a gap during installation.

PROCEED WITH CAUTION WHEN SANDING JOINTS



H

Cherry's fickle nature crops up when a formerly flush joint develops a lip. Take care not to sand a divot into the wood as you level out the joint. Change sandpaper frequently for best results.

Give cherry room to move

Compared with other domestic hardwoods, cherry is fairly stable; however, Bruce warns that cherry can (and will) move. "Don't underestimate cherry's desire to move. I've seen a tabletop bend a #10 wood screw." According to Bruce, good design (and central air conditioning) helps finished furniture survive seasonal wood movement. The most frustrating problems happen "while parts wait to be assembled, and when bringing finished pieces in from the shop." During that wait, he says, the wood can move so much that you'll start to wonder if your saw or tape is off. To help compensate for dimensional changes that can make the assembly process disappointing, or even disastrous, Bruce has a few rules followed by everyone in the shop:

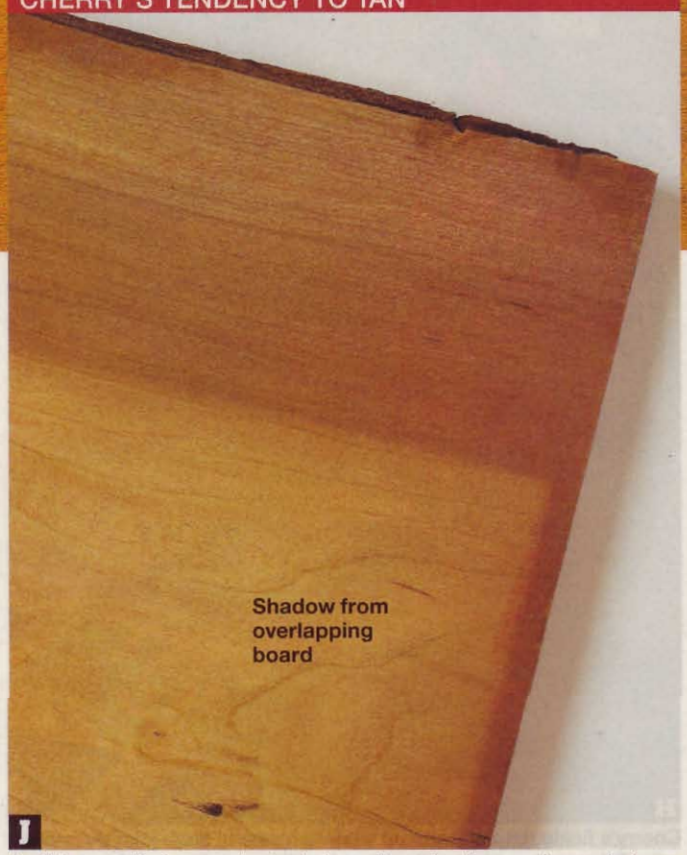
- **Cut pieces oversize.** To allow for movement that happens after a board is rough-cut, or moisture-related movement changes that occur from one day to the next, many parts are cut oversized and then sanded or planed to fit at final assembly (**Photo G**). "Unless you're assembling a piece right away, don't even think about tolerances tighter than 1/16"," Bruce says.
- **Avoid flush-fitting joints.** Cross-grain joints, such as where rails and stiles come together or where shelves meet face frames, can fit flush on one day and become offset on the next. "This is where even a little movement will show," Bruce says. To correct this problem, his worker spot-sands mating parts, as shown in **Photo H**. To conceal future movement, he cuts a small groove where the two parts meet (**Photo I**).
- **Watch your humidity.** Dry winter days prove even more damaging to your stock than the dog days of summer. "My heater would pull moisture from wood while it warmed up my shop," Bruce recalls. To prevent creating stress cracks in your stock, use a humidifier if moisture levels drop much below 20 percent.

HIDE WOOD MOVEMENT WITH A CHISEL

I

Cutting a small V-groove where two cross-joined boards butt together helps conceal future wood movement and adds a hand-tooled touch. Here, a sharp chisel and light touch do the trick.

CHERRY'S TENDENCY TO TAN



J

As this sample from a stack of cherry boards shows, cherry darkens dramatically in just a few months. To match new with old pieces, you can use stain or wait. Most change occurs in the first two years.

USE YOUR HANDS TO FINISH-SAND

K

Use 120-grit sandpaper to quickly remove tool marks and prepare the surface to accept an even finish. Not everyone finds the sweet-smelling sawdust pleasant. Regardless, be sure to wear a mask.

Getting a fine finish

Finishing remains the most challenging and confounding aspect of working with cherry. "When folks want a piece that is colored dark, I ask them to be patient," Bruce says. "Cherry's best color comes with time." (See "What makes cherry turn?" *opposite.*) When time allows, he prefers to use an untinted oil-varnish blend that lets the wood darken gradually on its own. But when matching a new piece to an old set, or when blending in a board that didn't want to turn like its neighbors, Bruce can mimic the color brought on by Mother Nature.

A good finish starts with careful sanding, but Bruce warns that you can have too much of a good thing, especially with cherry. "Over-sanding not only prevents stains from sticking but also can cause blotching," he says. Bruce explains that superfine grits or dull sandpaper burnish the surface, making it difficult for stains and finishes to get into the wood. To ensure absorption, he sands as little as possible, due in part to the fine planing and jointing the parts undergo. For pieces that will be stained, he only hand-sands with 120 grit to remove scratches that resulted from resting the furniture on the workbench. For clear-coat surfaces, Bruce hand-sands with 100 grit (**Photo K**), then applies the clear coat. Next, he hand-sands with 220 grit between the two to three clear coats. Finally, he smooths this surface with 0000 steel wool.

Even after sanding, problems can lurk. The reason: resin deposits might look darker after you apply an oil or stain. These spots absorb finish differently than surrounding wood. "It's one of the risks of working with cherry," Bruce says, "You can never be certain how it will turn out." While some woodworkers blotch-test boards with mineral spirits, Bruce isn't a big fan of it. "We do not test new finishes on sample boards unless we see a problem in production."

"When folks want a dark-colored piece, I ask them to be patient," Bruce says. "Cherry's best color comes with time."

In Bruce's words, "a clear film-forming finish doesn't need retesting, provided your application technique remains consistent." (Bruce uses a custom blend, but his technique can be adapted to work with another tung oil-varnish blend. (See **Sources,** *opposite.*) "The trick is to use light, even coats," he says. "The oil penetrates into the wood and brings out the grain's color, while the varnish seals the surface making it somewhat more water- and stain-resistant."

Blotching can be disastrous when using dyes or chemical stains, such as sodium hydroxide. Bruce avoids these by relying on his spray equipment to apply stain in light, misting coats. Unlike a stain-soaked rag that allows thirsty patches of wood to absorb too much stain and produce a blotchy look, the spray gun applies a uniform layer of stain over the surface. You can achieve similar blotch-control with a thick-bodied gel stain. Unlike thinner liquid stains that tend to be sucked in by the wood, gel stains stay on top of the wood. You can adjust the color simply by leaving more or less gel on the surface. Once dry, seal the color under a coat of shellac or varnish. Just remember that adding color is a compromise. "Too much stain can muddy up the color of the wood," Bruce says. "Nothing can compete with a natural patina gained over time."

No piece leaves The Sampler's shop without a final coat of wax to add extra luster and showroom slickness to the surface of the wood (**Photo M**). As when applying a stain or film finish, Bruce stresses that it's

FINISH CHERRY WITH A LIGHT TOUCH

L

To avoid the blotching that occurs with overly thirsty patches of grain, a worker uses a spray gun to finish and seal the wood, using light, even coats.

WAX ON, WIPE OFF FOR A FINAL SHEEN

M

After three coats of an oil-varnish blend and a light burnishing with 0000 steel wool, the finished piece is given a light coat of wax. The light wax topcoat makes the wood shine like stone.

"Too much stain can muddy up the color of the wood," Bruce says. "Nothing can compete with a natural patina gained over time."

best to use as little material as possible. To ensure this, he wipes on a watery wax solution that begins to evaporate almost as soon as it makes contact with the wood. (Bruce uses his own proprietary blend. For a close match, see **Sources**, *below*.) Working one section at a time, the finisher then chases drying wax with a clean rag before it gets too hard to buff. "The wax doesn't give much added protection, but it does bring out the beauty of the wood." Bruce says. The result: classic furniture bound to please.

Written by **Joe Hurst-Wajszczuk**
Photography by **Mike Stutler**

What makes cherry turn?

No one really knows what turns salmon-pink wood into a translucent amber brown. Light exposure plays a big part, but boards kept in a pitch-black attic or basement will develop this "patina" in time. Boards cut from the same tree tend to turn at the same rate, but there's no guarantee. How the board was cut relative to the growth rings may have as much to do with the transformation as the tree itself.

To even out the changing color, Bruce advises customers to leave tops clear of lamps or tablecloths for the first six months. (The wood will continue to darken for years, but at a slower rate.) While some sunlight is good, you can get too much. Overexposure can bleach out the color, the opposite effect of what you're after.

Despite careful selection and planning, there are times when a board won't turn like its neighbors. "It's just the nature of cherry," Bruce says. "Some will ask me to even out the color with stain, while others wait and see how it will even out in time."

For more on the experts who helped with this article, visit their Web sites at: samplercherryfurniture.com and foleyhardwoods.com.

Sources

Tung Oil Varnish: J.E. Moser's Polymerized Tung Oil Varnish No. 860-071, $14.99 (quart), Woodworker's Supply 800/645-9292; woodworker.com.

Liquid Wax: General Finishes Satin Finishing Wax No. 80707, $7.79 (pint). Call or click Rockler, 800/279-4441; rockler.com.

how to plan a project...

Define the need...

research the idea...

You've built several projects from magazine plans, and that's fine. But now you're ready to embrace the next big step: designing a project from scratch. Several factors lead to this point. It could be that no plan currently exists for the look you want, or you've admired a furniture piece at a local store, but don't care to pay the hefty asking price. It could be, too, that your level of woodworking confidence, skill set, and tool collection caused that little voice inside to say "Go on, design a project; you're ready—it could be fun." To get started, use the following formula to turn your idea into building-ready drawings in a wink, a week, or somewhere in between.

Job 1: Define the need

Begin the process by answering questions about the project's purpose. Are you short on storage? Do you need more countertop space? More seating? Are you following through on an interior design plan that calls for select handcrafted accents? Do any other concerns come into play? (See "Other considerations...." *below*). Ask the kind of questions that will help you create a three-dimensional solution for your need. The furniture-design team at *WOOD*® magazine suggests addressing the following:

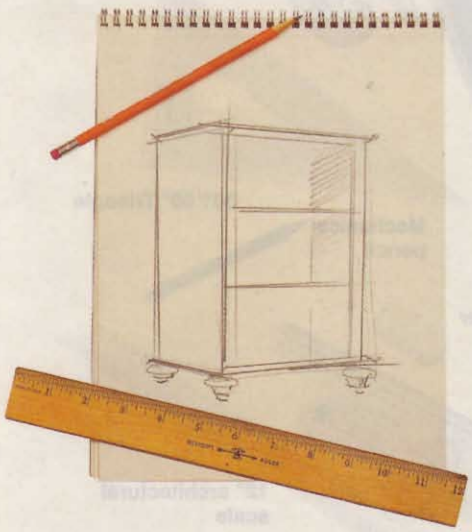
- **How will the project be used?** (Give the piece a name: coffee table, glass-enclosed display case, multiple-photo picture frame.)
- **Where will you place the project?** Indoors or outside? If indoors, in what room? Location impacts styling. For instance, a child's room wall shelf may be whimsical and painted in bright colors, unlike a dining room shelf that requires a more formal look.
- **Will the design be a known furniture style, such as Arts & Crafts or Shaker, or**

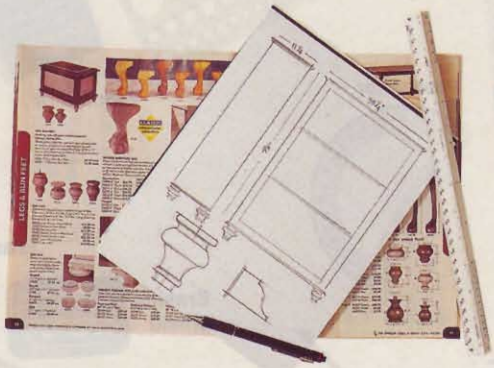
Other considerations to review before you start

It's not always function or style that drives a design. Other factors include:

- **Rainy-day wood stash—** All of us set aside stock featuring outstanding figure, color, and grain pattern that we want to use in a showy way in just the right project. The intended design must, therefore, incorporate this treasured stock.
- **Going with tools and skills you possess—** Due to costs you may not be able to afford that one tool your original project idea calls for. This may, for example, mean opting for dowels instead of biscuits until you can afford a biscuit joiner. Tenons would be better still, but you have to feel confident in cutting the tenons and mortises to exact dimensions.
- **Working with special hardware—** Perhaps you found some classic brass drawer pulls at an estate sale or chose to fashion your own hardware from scrap metal. In either case, this impacts other design elements, such as the style of molding, doors, and drawers.
- **When the project uses sheet goods—** Here, keep parts within a practical size. For example, make a cabinet side 23¾" wide instead of 24¾". This lets you cut two sides from a 4'-wide piece of sheet goods. Doing this cuts significantly down on your cost for materials and leaves little waste.

...from start to finish





rough-sketch it... → **make dimensioned working drawings...** → **build and finish your masterpiece.**

will you opt for an original style? You may want to mix and match style elements and joinery to achieve the desired look.

■ **What is the scale of the project?** It should be sized to the intended location. Taller rooms, ones with 12' ceilings, may accommodate taller, grander furniture and accent pieces—9' hutches and 4'-square picture frames, for instance. A room with greater lengths and widths may allow for longer, wider tables.

Also, be aware that standard ergonomic sizes for such things as chairs, cabinets, countertops, and so on exist. (More on this later.) If, however, the perceived users of the project are taller or shorter than the norm, alter the design to suit them.

Using scrap from the wood set aside for your project, test various stains and finishes to arrive at the color and sheen you're after.

■ **If you need to make a storage unit, what items will it hold?** Knowing this tells you how to divide up the space in the project. Measure the items to help size the project and such key parts as shelves, drawers, doors, and sides.

Job 2: Research the idea

Now that you've narrowed your idea to the type of project, the need it will serve, the style, and size, it's time to flesh out your design through research. Try these results-driven strategies:

■ **Collect ideas from project books and magazines, ads, online sites, furniture stores, catalogs, antique malls and museums.** If replicating an actual piece, take photos of it and document the dimensions. (See how to do this in the October 2005 issue of *WOOD* magazine, page 20.)

■ **Decide on joinery, relying on joints found in similar pieces.** Consider the project's use, degree of strength needed, and the thickness of the joint members.

■ **Choose hardware based on the project's style.** Check catalogs or visit local home centers or woodworking supply retailers. Then, purchase the hardware to have it on hand when drafting the dimensioned working drawings of your design.

■ **Finally, select the woods and finish.** Sometimes the style you choose will determine these for you. A faithful Arts & Crafts piece may require quartersawn oak, for instance. Once you know your woods, make finish test samples to achieve the color and sheen you want, as shown at *left*.

Job 3: Rough-sketch it

■ **Rough-sketch your design idea.** Use a basic sketch pad, pencil, and ruler. If you have them, include overall dimensions at this time; customize the idea as needed.

■ **Refer to *Architectural Graphic Standards* for proportioning projects to common sizes for average humans.** (Find the book at the library—it's costly to buy at $226.) Or take overall dimensions of similar pieces.

A basic design kit

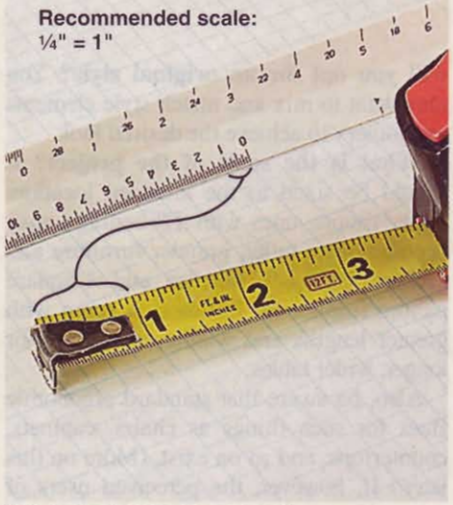
Job 4: Make dimensioned working drawings

Now for the fun part—transforming your research and rough sketch into an accurate set of working shop drawings that you can build from. Here's how:

■ **Assemble a basic design kit.** You'll need many of the items *above*. As an alternative—if you own a Windows-based personal computer—consider buying an inexpensive design program. See some choices in "Opt for CAD," *below*.

■ **Next, draw dimensioned front and side elevations of your project.** Also, draw any subassemblies (drawers, doors, etc.), and details. See the *previous page, top center.*

■ **Draw the shape (or part view) for every piece, including dimensions.** Note special machining, and the number of parts needed. Also give the part a name, and indicate its location in the design. For example: "cabinet left side," "middle divider," and so on. At *WOOD®* magazine, we letter-label every part in its order of construction, with part (A) the first part built. (Later, transfer the letters to the actual parts to maintain order.)



The easiest scale to work with when transferring project dimensions to gridded paper is where ¼" equals 1".

■ **Using gridded paper, create a cutting diagram for wood materials.** Figure on 15 percent waste, and while you're at it, do a materials list. See the projects throughout this magazine for examples. Better still, go to woodmagazine.com/designhelp for a blank cutting diagram and materials list.

■ **Assemble a shopping list of any needed supplies and special tools or bits.**

Now, with your dimensioned shop plans and materials on hand, there's only one thing left to do—Job 5: Start building!

Written by **Jim Harrold** with **Kevin Boyle**

Opt for CAD

More and more woodworkers are turning on their computers to turn out a design. To do this, buy and install a computer-assisted-design (CAD) software program. You don't need to spend a lot of money on it. We found several on the market for $50 or less.

Two in this price range include TurboCAD (version 11) for $30, and DesignCAD Express (version 15) for $50. Both can be found at retailers selling computers, such as BestBuy and CompUSA.

With the features in these programs you can make 2-D dimensioned drawings of anything from furniture to a deck to a house floor plan and more. The drawback lies in the time it takes to learn the program. That's time lost if you're eager to get started drawing your design. On the upside, the software programs typically come with a tutorial CD and reference book that show and tell how to use the various desktop tools. Better still, you easily can make several variations of your design, or alter it with just a few mouse clicks.

The basic CAD design kit shown here includes a CD design program, tutorial book, and CD tutorial. Cost: $50.

flower-blossom hummingbird feeder

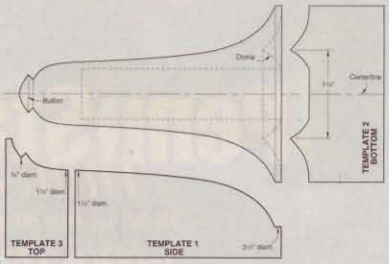
Create a buzz in your neighborhood with this alluring turning project.

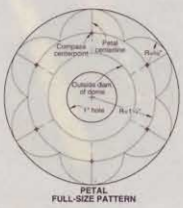
This fanciful feeder requires only three things: a turning blank, a feeder kit, and a couple of relaxing hours at the lathe. (See **Source** on *page 83* for the feeder kit.) The trick to forming the petals involves nothing more than a coping saw. And the sidebar on *page 83* tells you everything you need to know about feeding hummingbirds. So let's get started.

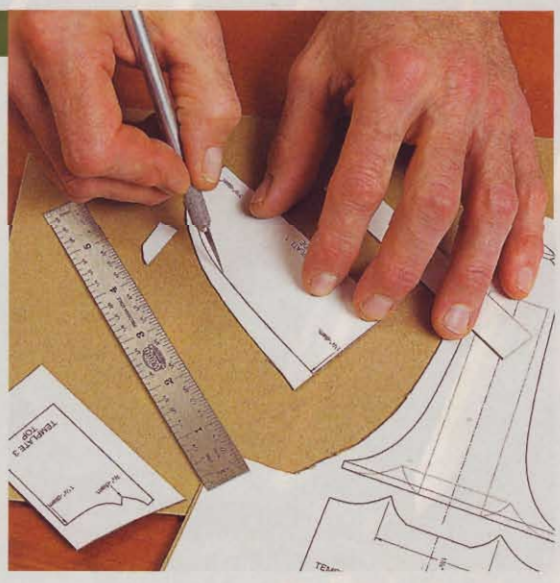
1 Make the templates and the turning blank

Photocopy **Templates 1**, **2**, and **3**, and the **Petal Pattern** on the *WOOD Patterns®* insert. Adhere the templates with spray adhesive to heavy card stock. Then using a straightedge and crafts knife, cut the templates to shape, as shown at *right*. Cut the **Petal Pattern** along the outside circle.

To make the turning blank, cut five ¾×3¾×6½" pieces of weather-resistant stock. (We used mahogany.) Laminate the pieces using waterproof glue, keeping the edges and ends flush. (Use polyurethane glue or Titebond III for this.) You can also use a 4" turning square 6½" long.

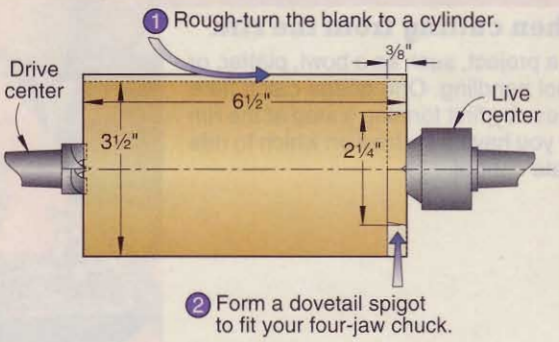






2 Turn the blank and form a spigot

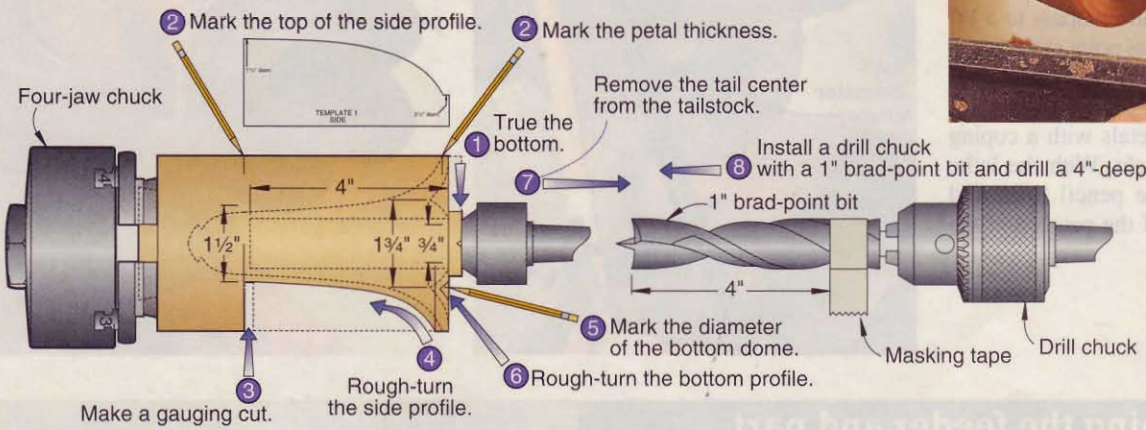
Tools: ¾" roughing gouge, 3/16" parting tool, ¾" skew chisel.
Tool rest: Gouge and parting tool, at center; skew, slightly above center.
Speed: 800–1,200 rpm.



Mark the centers of the blank ends, and mount it between centers on the lathe. (We used a live center in the tailstock.) Use a roughing gouge to turn the blank to a 3½"-diameter cylinder. Then on the side of the blank, mark the length of a dovetail spigot to fit your four-jaw chuck. (The spigot must not bottom out in your chuck. Our spigot is ⅜" long.) Use a parting tool to turn the spigot to fit your chuck, as shown *above right.* (We turned our spigot to a 2¼" diameter.) Now use a skew chisel to undercut the spigot, matching the angle of the chuck jaws.

3 Rough-form the profiles and bore the center

Tools: ⅜" bowl gouge, parting tool, 1" brad-point bit.
Tool rest: Gouge, slightly below center; parting tool, at center.
Speeds: Lathe tools, 1,200–1,600 rpm; drilling, 800–1,200 rpm.

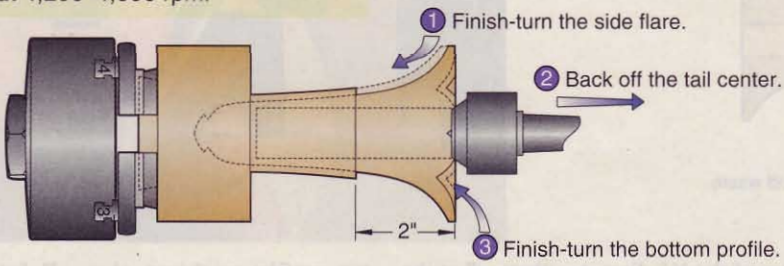


True the blank bottom with a bowl gouge, cutting from the edge to the center. Then using **Template 1**, mark the petal thickness and the top of the side profile on the blank. Using your parting tool, make a gauging cut to a 1½" diameter at the top of the side profile. Returning to a bowl gouge, rough-turn the side to within ⅛" of the finished profile. Mark the bottom dome diameter, and rough-turn the bottom profile, as shown *top right.*

Back the tailstock away and remove the tail center. Install a drill chuck and a 1" brad-point drill bit. (See **Source.**) Mark a 4" depth on the bit with masking tape, and bore a hole for the feeder tube insert.

4 Finish the side flare and the bottom

Tools: ⅜" bowl gouge.
Tool rest: Slightly below center.
Speed: 1,200–1,600 rpm.

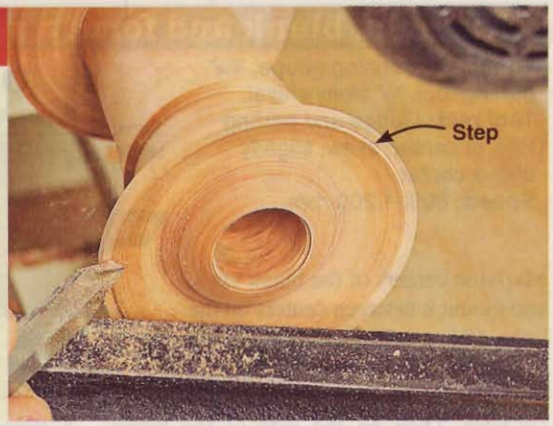


Install the live center in the tailstock, and insert the beveled portion of the center into the 1" hole. (If your live center is too small for the hole, insert a 4¼"-long piece of 1" dowel to engage the center.) Then use a bowl gouge to finish-turn the flared portion of the side profile, as shown *above right.* Finish-sand the outside of the flare. Now back the tail center away and finish the bottom profile. To reduce the chance of a tool catch when starting a gouge cut at the rim of a project, see the **Turning Tip** on *page 82.*

TURNING TIP

How to avoid gouge catches when cutting from the rim

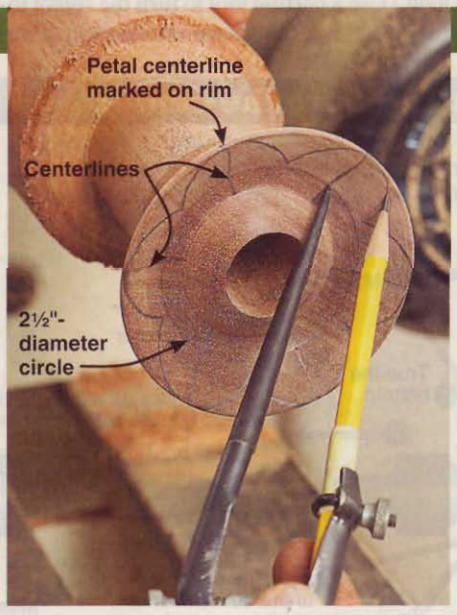
Starting a gouge cut at the outside rim of a project, such as a bowl, platter, or this hummingbird feeder, takes careful tool handling. One gouge catch here can ruin the entire piece. Guarantee success by first forming a step at the rim with a parting tool, as shown at *right*. Now you have a surface on which to ride the bevel of the gouge, giving you complete control.



5 Form the petals

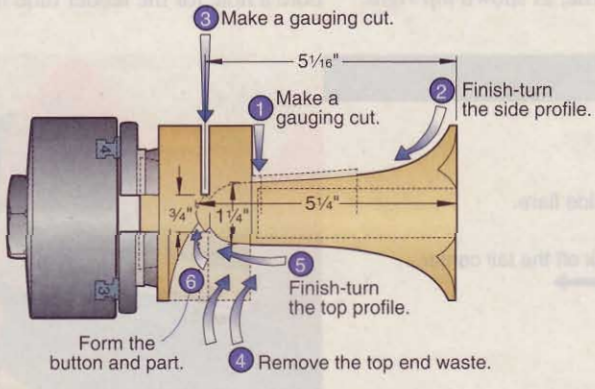
Tools: Compass, coping saw.

Retrieve the **Petal Pattern**, and use it as a guide to mark petal centerlines on the rim of the blossom. Then position the tool rest as a straightedge and draw the centerlines. Draw a 2½"-diameter circle, where indicated on the pattern. Now set your compass to a ⅝" radius, locate the compass point at the intersections of the circle and the petal centerlines, and draw the petals, as shown at *right*. Finally, cut the petals with a coping saw, as shown at *far right*. With the lathe stopped, sand away the pencil lines and finish-sand the edges of the petals and the bottom of the blossom.



6 Finish shaping the feeder and part

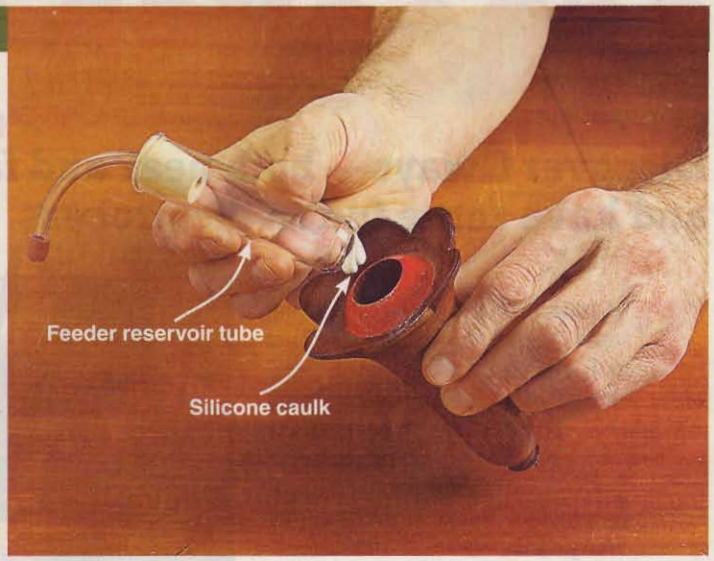
Tools: Parting tool, ⅜" bowl gouge.
Tool rest: Parting tool, at center; gouge, slightly below center.
Speed: 1,200–1,600 rpm.



Using a parting tool, make a gauging cut to a 1¼" diameter at the top of the side profile. Checking your progress with **Template 1**, use a bowl gouge to finish-turn the profile. Then using **Template 3** as a guide, mark the location of the ¾"-diameter "button" at the top of the blossom, and make a gauging cut with a parting tool. Now use the bowl gouge to remove the top end waste, and checking your progress with **Template 3**, form the top profile, as shown *above*. Before completely forming the button, finish-sand the outside profile, staying clear of the petals. Finally, part the blossom from the waste and finish-sand the top of the button.

7 Apply the finish and assemble

Drill a pilot hole for the brass eye screw included with the feeder kit, centered in the top of the feeder. Then apply a liberal coat of oil finish, repeatedly soaking the piece inside and out until the wood grain is saturated. (We used Watco natural Danish oil finish.) After removing any drips, let the finish dry thoroughly. Sand away any roughness with 220-grit sandpaper, and install the eye screw. Now, hang the blossom on a wire, and apply three coats of exterior polyurethane, lightly sanding with 220-grit sandpaper between coats. (We used gloss Minwax Helmsman Spar Urethane in a spray can.) With the finish dry, apply red oil-based enamel to the bottom dome with an artist's brush. When the paint dries, apply a dab of silicone caulk to the end of the feeder reservoir tube, slide it into the blossom, as shown at *right*, and let the caulk cure. Fill the tube with nectar and press in the feeder tube stopper. (See the sidebar *below* for a recipe.) Now hang the feeder, and watch for the arrival of your new feathered friends.



What you need to know about hummingbirds

Before you hang out your feeder, here are some things that will guarantee success in attracting and feeding hummingbirds.

Nectar recipe. Mix one part sugar with four parts water and boil for 1–2 minutes. Let the nectar cool, and store it in the refrigerator. Do not use honey or artificial sweeteners in your nectar. Honey ferments easily and can harm hummingbirds, and artificial sweeteners have no food value. Do not use food coloring.

Attracting hummingbirds. Red on a feeder attracts hummingbirds. If your feeder doesn't seem attractive enough, tie a red ribbon to it. Hummingbirds prefer natural nectar, so feeder activity slows as flowers bloom in your yard. The birds will feed more often as the blooms diminish. Native to the eastern United States, ruby-throated hummingbirds are territorial and defend flowers and feeders within their home turf. To attract more hummingbirds, hang additional feeders out of sight of each other.

Feeding season. Most hummingbirds are migratory, arriving in Florida as early as January and the upper Great Lakes in May. Hang your feeder 5–10 days before the average arrival date for your area so the birds will be attracted to your feeder and possibly stay for the season.

Fall migration. This annual pilgrimage is triggered by changing day length, not the availability of food, so hummingbirds may start to migrate before flowers wane. To help migrating hummingbirds, leave your feeder up at least two weeks after feeding activity decreases.

Feeder care. Clean your feeder and change the nectar every 3–4 days; more often in hot weather. Never use detergent to clean your feeder, simply rinse with hot water. Scrub away mold (black spots) with a bottle brush. Monitor nectar consumption, and fill the feeder with the amount that will be used between cleanings.

Source

Feeder kit. 1"-diameter 4"-long glass reservoir tube, rubber stopper, feeder tube, brass eye screw, kit no. 931-1000, $3.99 ppd. Call Craft Supplies USA, 800/551-8876, or go to woodturnerscatalog.com.

Drill bit. 1" brad-point drill bit no. 971-0101, $19.99 ppd. Craft Supplies USA, see *above*.

Written by **Jan Svec** with **Phil Brennion** and **Jeff Mertz**
Project design: **Phil Brennion**
Illustrations: **Roxanne LeMoine**

Post questions on this project or any turning technique at woodmagazine.com/turning. Professional turner Phil Brennion monitors this forum, and he and other turners will be happy to assist you. To see more projects go to woodmagazine.com/turnedprojects.

schoolish pleasures

Discover 6 ways— both near and far— to learn more woodworking and have some fun in the process.

The learning curve for woodworking starts the day you pick up your first tool and ends...well, never. And while working in your shop and learning through trial and error can teach you much, you can accelerate your climb up the curve by taking advantage of the numerous educational opportunities found in every corner of the country.

To help you zero in on the skills and techniques you want and need—regardless of your skill level—we assembled a variety of action plans. They cover anything from an evening workshop in basic tool use to a formal degree program. Find something that fits your wallet and schedule, and then sign up to be a better woodworker.

Photo: Des Moines Woodworker's Association

Turning instructor Chuck Dowler, left, demonstrates turning techniques to members of a skill-building class sponsored by the Des Moines Woodworker's Association.

ACTION PLAN 1

Enroll in adult education

Many high schools have replaced their woodshops with computer labs, but not all have given up on woodworking. At many of these high schools you will find adult-education classes in basic hand tool use, safe power-tool operation, and advanced offerings.

Community colleges also offer adult education classes for woodworkers. Classes usually are held one or two nights a week for several weeks. In many of these classes you can build a project of your choosing under the supervision of a qualified instructor.

Make it happen

Call your state's department of education or local school district to find a school with adult woodworking classes in your area. Also, check online to see if the local high school or community college has information there, including class locations, times, and cost.

Photo: Oregon College of Art & Craft

Beading technique is the focus of this aspiring woodworker at an Oregon College of Art & Craft evening class.

ACTION PLAN 2

Check out local retailers

Local woodworking supply stores often have seminars and demonstrations to help woodworkers learn techniques and skills. Some retailers offer hands-on classes where you can build projects in the store's shop under the supervision of qualified instructors.

On occasion, these retailers also will bring in "celebrity" woodworkers to rub elbows with the customers, demonstrate techniques, and answer questions. Finally, you may find new product demonstrations that help you learn about advances in the woodworking industry.

Make it happen

Call your local woodworking supply store or lumber supplier to find out what they have to help you grow as a woodworker. A few retailers that have classes and workshop demos are: Home Depot, homedepot.com; Lowes, lowes.com; Rockler Woodworking and Hardware, 800/279-4441; and Woodcraft Supply, 800/225-1153.

Photo: Woodcraft, Manchester, Connecticut

Students work on kayaks while under the watchful eye of the class instructor at the Manchester, Connecticut, Woodcraft Store.

ACTION PLAN 3

Join a woodworking club

One of the best ways to gain woodworking knowledge is from other woodworkers. Local woodworking clubs or guilds meet regularly, bringing together a wealth of woodworking experiences. Members often help inexperienced woodworkers one-on-one with woodworking problems. These clubs may sponsor seminars by professional woodworkers at a reduced member rate. Many times the clubs have smaller "splinter" groups devoted to a particular tool or discipline, such as carving, turning, or scrollsawing. Clubs often take field trips to workshops, museums, and other woodworking-related attractions.

Make it happen

Check with local woodworking supply stores and lumber dealers to get the names and phone numbers of the woodworking clubs and guilds in your area. A quick way to locate such a club or guild can be found online at woodmagazine.com/clubs.

Photo: Des Moines Woodworker's Association

At this meeting of the Des Moines Woodworker's Association, hosted by The Woodsmith Store, members listen to finishing expert Bob Flexner.

ACTION PLAN 4

Attend a woodworking show

Woodworking shows provide another great way to expand your woodworking knowledge. These traveling shows bounce from city to city and bring together woodworking retailers, manufacturers, and customers in one location, giving the woodworker access to information and products to improve skills. You can attend workshops and seminars presented by experienced woodworkers where you witness techniques performed and get answers to your questions. The only drawback: little—if any—hands-on opportunities.

In many cities, local tool dealers conduct product shows or tent sales, where tool manufacturers introduce new products and demonstrate product lines. At these shows, tool representatives will talk to you face to face and answer any specific question you might have about a tool or its operation.

Make it happen

To find a woodworking show in your area, check online at thewoodworkingshows.com or with a local woodworking retailer for any information on dates and workshops.

Photo: Jill Kuhn

WOOD® magazine Contributing Craftsman Jim Heavey explains woodworking techniques to attendees during a seminar on The Woodworking Show circuit.

ACTION PLAN 5

Attend a destination woodworking workshop

For the woodworker seeking special training and who has the time and budget, consider a destination woodworking school. You can find these in all parts of the United States and Canada, representing every kind of woodworking. Want to learn how to build a Windsor chair or turn a bowl? There's a school for you. Most of these offer weekend classes and weeklong classes, and some classes run as long as six weeks. You can even find destination schools in vacation areas where you can attend class while your family enjoys other attractions.

Some of the details you will want to check when looking for a workshop are fees and deposits, required tools and materials, and lodging and meals. Workshop literature and Web sites often itemize every cost, but double-check with a phone call. Many classes fill up months ahead of time, so plan accordingly.

Make it happen

To find a destination woodworking school, search the Internet for woodworking schools. Be sure to ask for references and names of other woodworkers that have attended the school. American Sycamore Woodworker's Retreat, 765/795-4044; Anderson Ranch Arts Center, 970/923-3181; Connecticut Valley School of Woodworking, 860/647-0303; and Marc Adams School of Woodworking, 317/535-4013, are a few such destination woodworking schools.

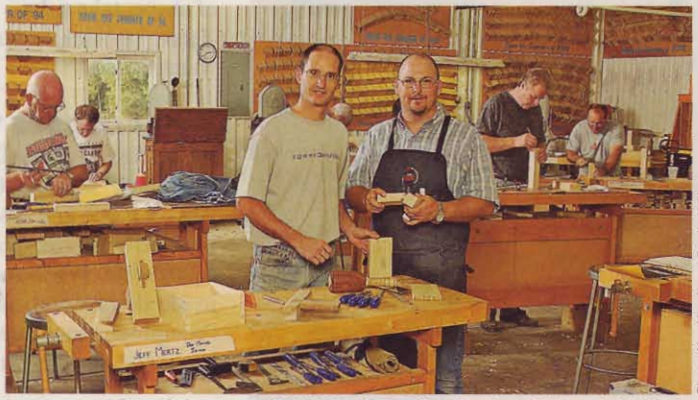


Photo: Ken Kneringer, Studio K Photography

Instructor Marc Adams and *WOOD* Magazine Design Editor Jeff Mertz discuss mortise-and-tenon joinery at a recent workshop.

ACTION PLAN 6

Enroll in a degreed woodworking program

Many community colleges and state universities offer certificates and degrees in woodworking for the aspiring professional. You can enter a two-year program and earn an associate degree in woodworking, or opt for a four-year program and receive a bachelor's degree in furniture design and woodworking. Consider this type of program if you have the desire and time to learn woodworking's more refined points and furniture history.

Photo: Oregon College of Art & Craft

Students at the Oregon College of Art & Craft work on several projects on the way to a degree in woodworking.

Make it happen

To find a program near you that offers woodworking degrees, check with your local universities and community colleges.

when good wood goes bad:

how to deal with warped boards

Cutting rectangular boards from a round tree sometimes results in stock that distorts as it dries. You still can make this lumber work in your shop.

We've all been there: You go into the workshop on Saturday morning to dig into a project, only to find that beautiful lumber you bought a week ago warped from its straight and relatively-square shape. Unfortunately, wood often changes shape naturally due to a variety of factors, some of which you can control and some you can't. Before you get bent out of shape, take a deep breath and remember: There are simple guidelines to deal with warped wood.

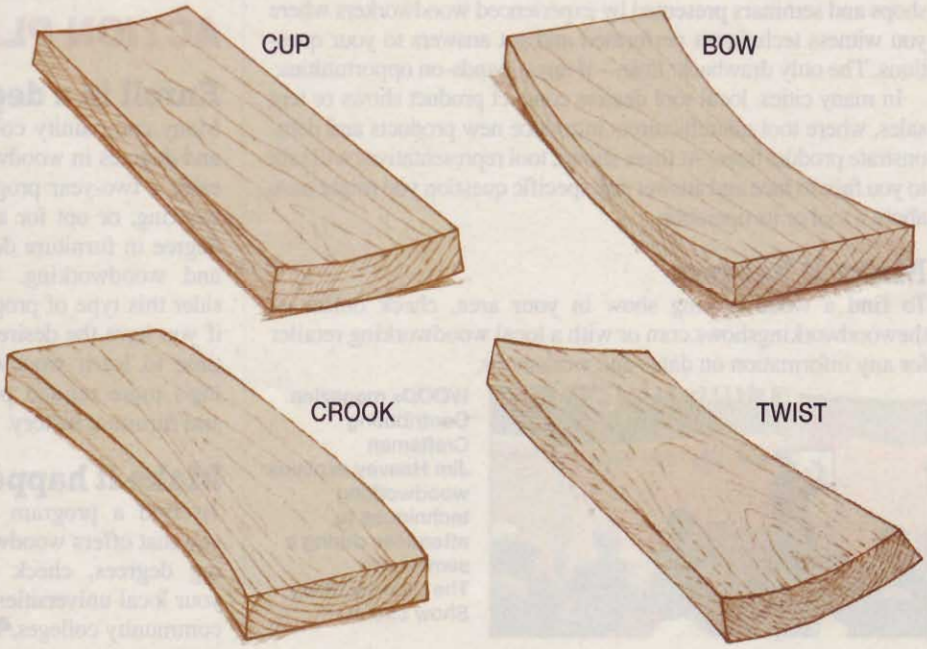
What causes warping?

At its most basic level, a tree consists of cells containing water, a tree's lifeblood. When you cut a tree and saw it into lumber, it must be dried to remove most of that water to make it workable. When the amount of water left inside dried wood stabilizes, it has reached "equilibrium moisture content," or EMC. For hardwoods in the United States, that figure averages about 11 percent in the humid Southeast, to 6 percent in the desert Southwest, to 8 percent in the rest of the country.

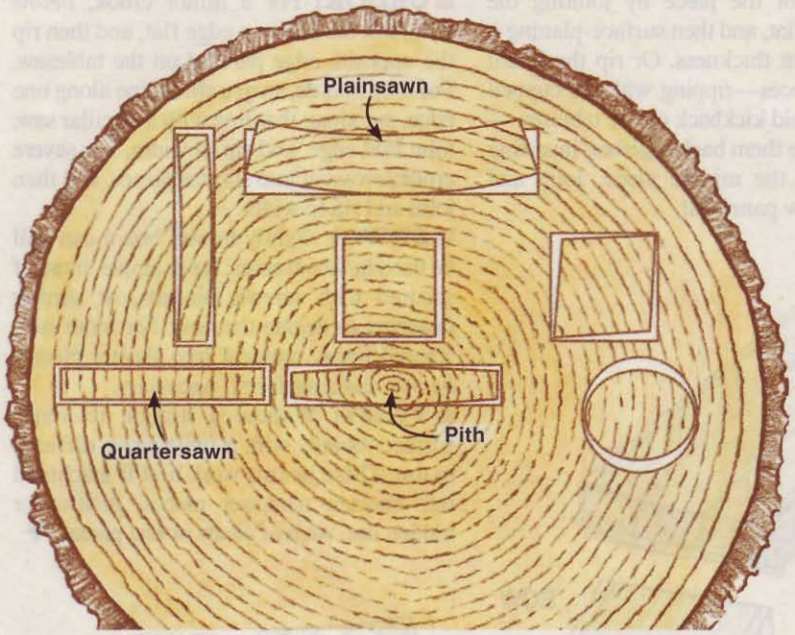
Once at EMC, wood can be machined or worked by hand with faith it will remain stable. But there's no guarantee it will remain at that moisture level because wood continues to swell in response to upticks in humidity and shrink as the air around it dries and draws moisture out through the wood's pores.

Warping typically takes one of four forms: cup, bow, crook, or twist. (See the illustrations, *below.*) A number of factors cause warping. First, where a board gets cut from a log has the most influence on movement. Shrinking and warping can be predicted based on the grain pattern and its orientation to the pith (or center) of a tree. (See the illustrations, *opposite, top.*) Second, defects that occur naturally within the tree can cause warping. For more details on these defects,

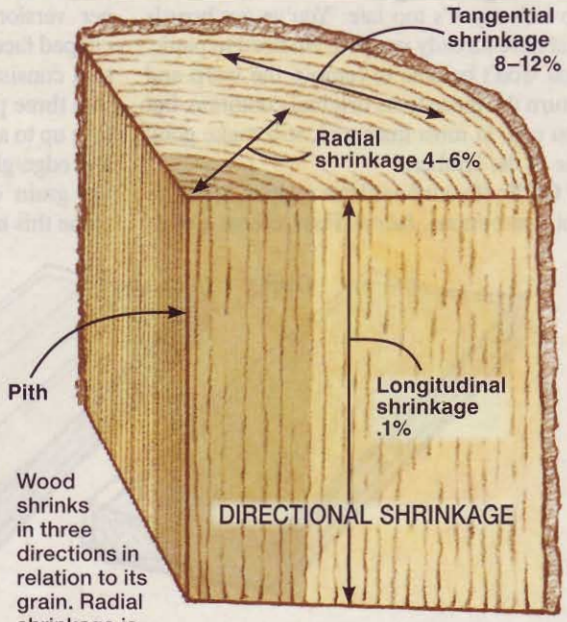
THE FOUR MOST COMMON FORMS OF WARPING



WOOD MOVES IN RELATION TO ITS LOCATION IN THE LOG



A board's position within the log determines its likelihood to warp. The quartersawn board shows minor and even shrinkage. By comparison, the plainsawn board cups away from the pith.



Wood shrinks in three directions in relation to its grain. Radial shrinkage is moderate and occurs perpendicular to the grain; tangential shrinkage is substantial and occurs perpendicular to radial; and longitudinal shrinkage, which is almost negligible, occurs parallel to the grain.

see "Less-than-ideal conditions cause stressed grain," on *page 88*.

Third, perhaps the lumber dried too quickly (causing splitting) or with too much or too little humidity. By themselves these don't cause warping, but they can accentuate the wood's characteristics that do cause it. Fourth, the environment in which you place your wood can cause dramatic changes, even in short periods of time, as the boards adjust to the humidity level. This you can control.

Preventive measures

To avoid or limit warping in your stock, the environment in your workshop and wood storage area should replicate the humidity and temperature levels of the setting in which your project will end up. A small window-unit air conditioner should suffice in most shops to reduce humidity. In the dry winter months, use a humidifier in conjunction with your heater. Avoid dramatic swings, maintaining these levels even when you're not in the shop.

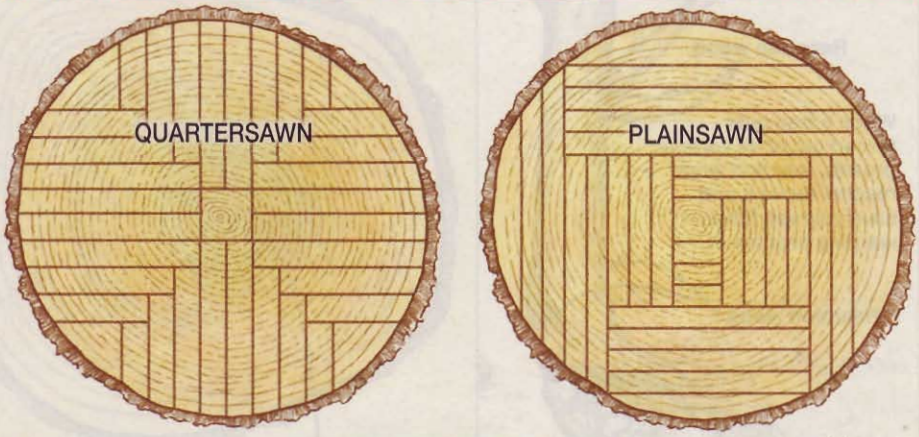
You also can reduce the risk as follows:

- Select boards by hand before you buy. Avoid boards with large knots or areas where the spacing (on the end grain) between a few rows of grain rings is much wider than the majority of rings.
- Although more expensive, quartersawn lumber, *right,* tends to warp far less than plainsawn wood.
- Buy only enough wood needed for your current project. This way all the lumber will be at a consistent moisture level, and you won't have a big stack of leftovers in your way. Also, getting all your wood at one time increases the chances of it matching.
- When you purchase stock, store it horizontally with plenty of stickers (narrow strips of dried wood inserted between boards) to allow air to circulate. Be sure the stickers are directly on top of each other throughout your stack. Then, give the wood at least two days to acclimate to your shop's environment.

In the *WOOD*® magazine shop, Master Craftsman Chuck Hedlund prefers to break boards down right away rather than leaving them in their original state. With a cutting diagram at the ready, Chuck first cuts workpieces to rough length, leaving them a few inches longer than finished length. Then he joints one face flat, and planes the other to remove the rough face. This gives each board more open grain to absorb or release moisture. After that, he lets the lumber sit for at least two days to allow it to acclimate to the moisture level in the shop. Then he machines it to final dimensions.

For sheet goods stored vertically, Chuck suggests using a few scrap blocks between the wall and stock to allow air to circulate. Also, leave a fan running just to keep the air moving. Never store lumber on a concrete floor, which can transfer moisture to your stock. Instead, stack it on 4x4s with stickers between layers.

SAWMILL DECISION: CREATE BETTER BOARDS OR PUSH PRODUCTION



Quartersawing logs (*left*) is more time-consuming and costly, but creates more stable lumber. Plainsawing (*right*), also known as flatsawing, is quicker and cheaper, but produces boards with grain direction more prone to warping.

Saving warped boards

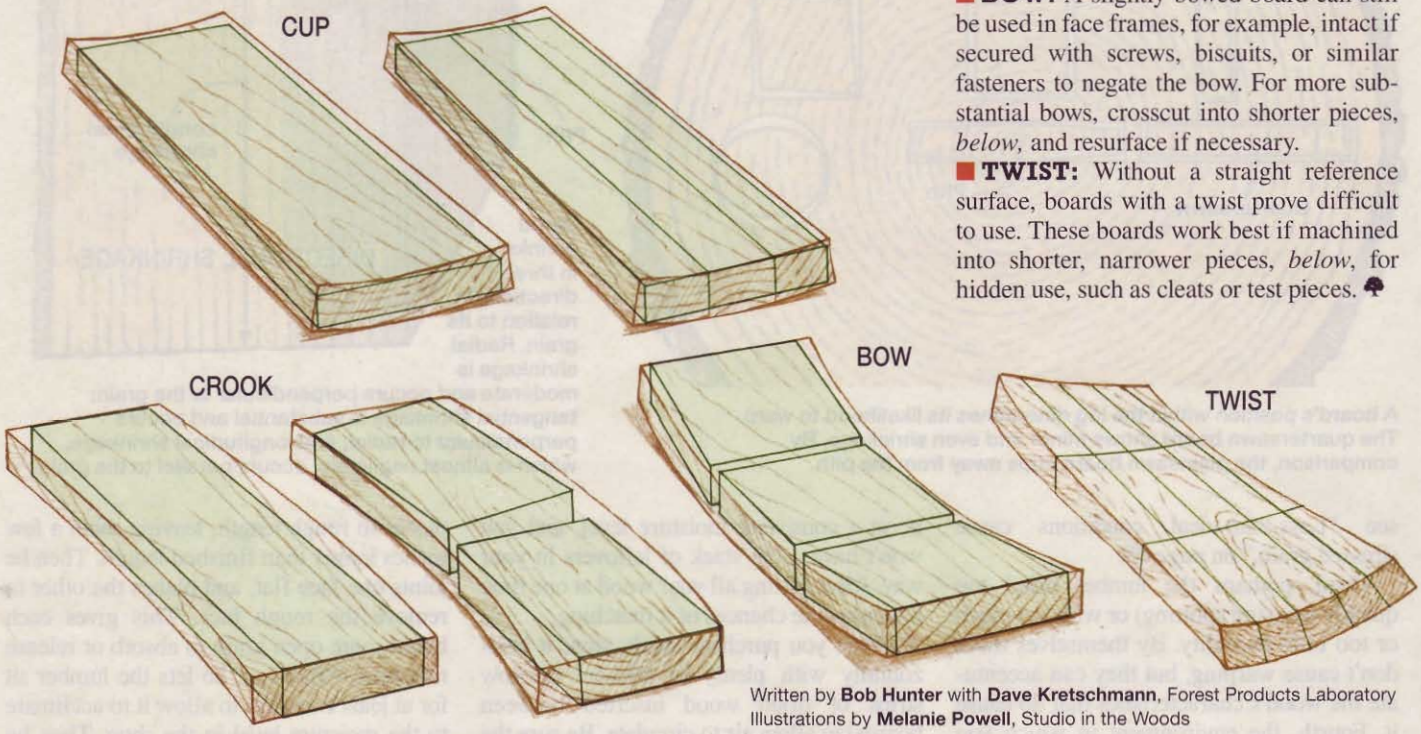
So let's say it's too late: You've got boards that have already warped. No need to panic. You won't be able to remove the warp and return the piece to its original condition, but you can, in most instances, still make good use of the lumber.

■ **CUP:** If your board has a cup in it, you've got two options, *below*. First, create a thinner version of the piece by jointing the cupped face flat, and then surface-planing it to a consistent thickness. Or rip the board into three pieces—ripping with the cupped face up to avoid kickback on the tablesaw—and edge-glue them back together, inverting the grain of the middle piece. Joint and plane this new panel flat.

■ **CROOK:** For a minor crook, *below left*, joint the concave edge flat, and then rip the opposite edge parallel on the tablesaw. For long boards, snap a chalk line along one edge, cut along that line with a circular saw, joint that edge, and rip to width. For severe crook, crosscut into shorter pieces, and then joint and rip to width.

■ **BOW:** A slightly bowed board can still be used in face frames, for example, intact if secured with screws, biscuits, or similar fasteners to negate the bow. For more substantial bows, crosscut into shorter pieces, *below*, and resurface if necessary.

■ **TWIST:** Without a straight reference surface, boards with a twist prove difficult to use. These boards work best if machined into shorter, narrower pieces, *below*, for hidden use, such as cleats or test pieces.



Written by **Bob Hunter** with **Dave Kretschmann**, Forest Products Laboratory
Illustrations by **Melanie Powell**, Studio in the Woods

Less-than-ideal conditions cause stressed grain

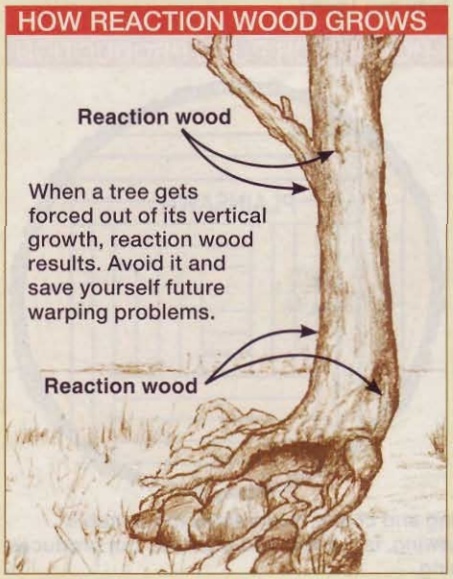
Trees have a natural attraction to the sun and its life-giving light. This makes trees grow, in most cases, straight up. When a tree gets forced out of that vertical plane, for example, by an intrusive neighboring tree or by growing on the side of a creek bank, as shown *below*, it will make every effort to correct itself and grow vertically again.

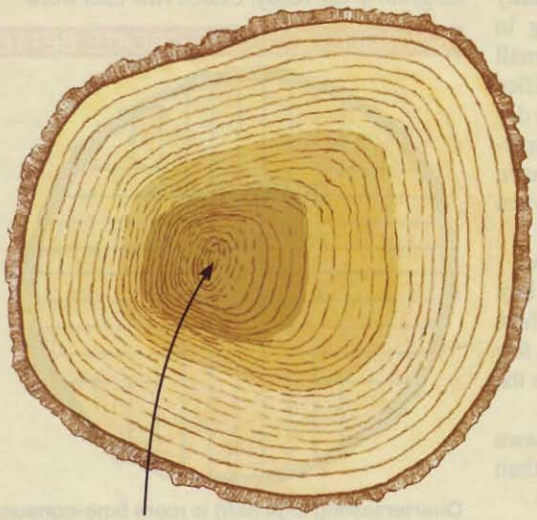
This "elbow" in the trunk produces stress that will result in warping should that part of the tree be sawn into lumber. Industry experts call this stressed grain "reaction wood," and it proves nearly impossible to detect in sawn lumber except to trained technicians who observe it on a regular basis.

Reaction wood is called tension wood in hardwood trees, and compression wood in softwood trees. Reaction wood tapers off as it moves away from the point of correction, so you'll be okay to save the log starting a couple of feet from the bend in the trunk.

You'll also find reaction wood where large limbs branch out from the trunk. This stressed wood lies in both the limb and the area of the trunk around that limb. Trying to save boards from a limb will only lead to frustration with warping later. As for the log, make your cuts a foot above and below the limb.

To spot reaction wood in a log, note areas with an asymmetrical or unusual change in ring thickness, as shown at *left*. Such wood is best saved for the woodstove or chipped and used in pressboard.

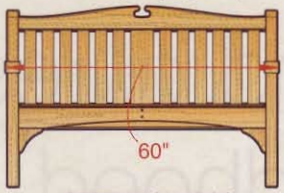

HOW REACTION WOOD GROWS
Reaction wood
When a tree gets forced out of its vertical growth, reaction wood results. Avoid it and save yourself future warping problems.
Reaction wood



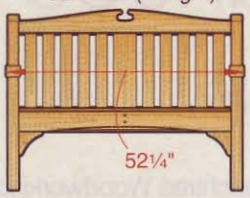
garden bench options

Simple changes to the bench on *page 40* yield a matching suite of garden seats.

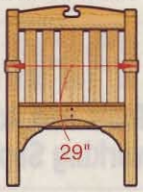
BENCH (On *page 40*)

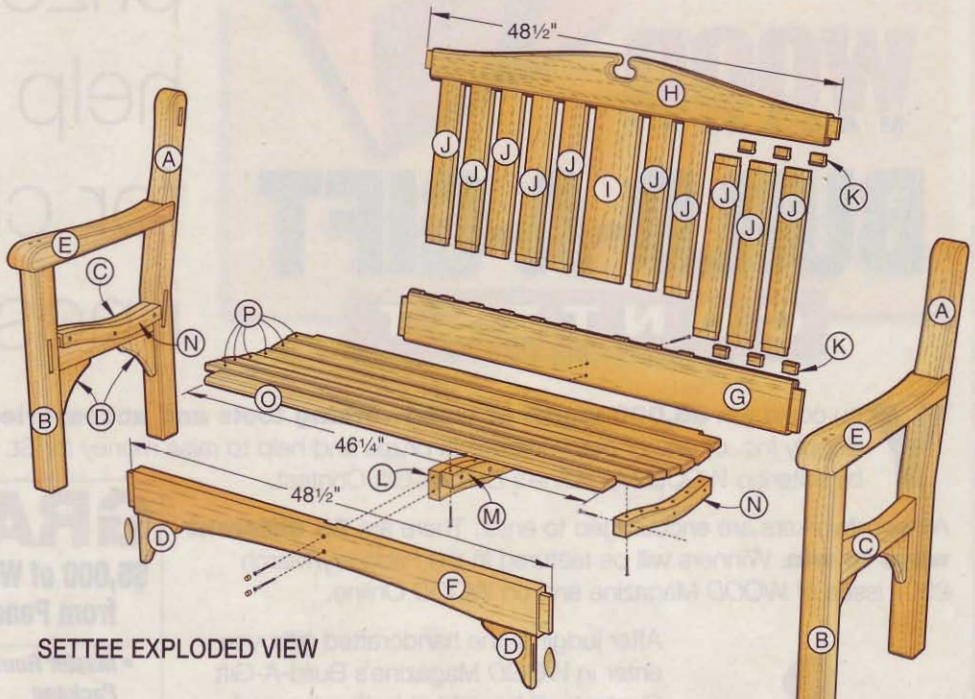


SETTEE (At *right*)



CHAIR (On *page 96*)





SETTEE EXPLODED VIEW

Now you can fulfill all your outdoor seating needs in traditional style. Just combine the instructions for the garden bench on *page 40* with the settee and chair drawings and **Materials Lists** at *right* and on *page 96* to build one or both matching pieces. Here's how.

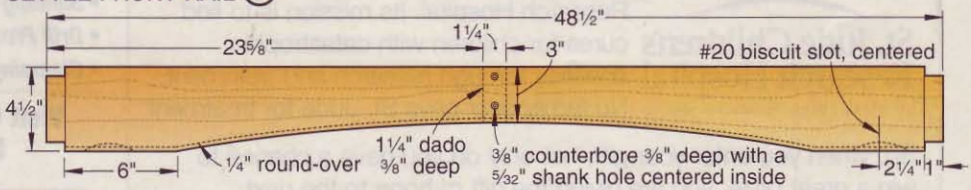
Following the bench instructions, make the end assemblies, parts A through E. When planing 2× stock to 1¼" thick, adjust the amount needed for the lengths of the settee and chair front rails (F), lower back rails (G), and upper back rails (H).

Continue following the bench instructions for making the front rails (F) and back assembly parts G through K, referring to the **Materials Lists** at *bottom right* and on *page 96* for the lengths of the rails (F, G, H) and number of slats (J) and spacers (K). Adjust the length of the spacer blank for the number of spacers needed. Then glue and clamp the front rails and back assemblies between the end assemblies.

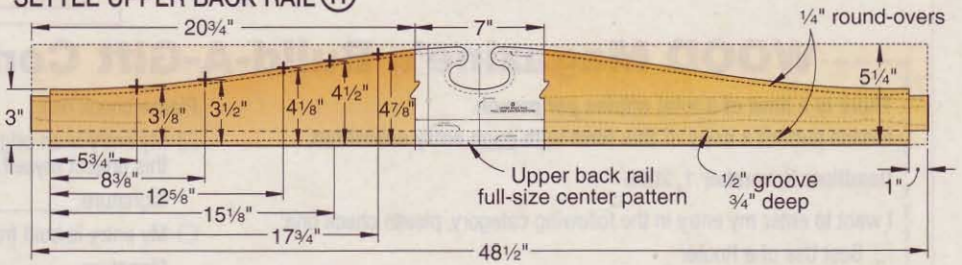
Add the center rail (L) and center cleat (M) to the settee and the end cleats (N) to the end rails (C) of both the settee and chair. *On the chair, omit the center rail (L) and center cleat (M).* Then cut the front seat slats (O) and seat slats (P) to size. Following the bench instructions, rout and

continued on page 96

SETTEE FRONT RAIL (F)



SETTEE UPPER BACK RAIL (H)



Settee Materials List

Seat		FINISHED SIZE T	W	L	Matl.	Qty.
F	front rail	1¼"	4½"	48½"	C	1
G	lower back rail	1¼"	5¼"	48½"	C	1
H	upper back rail	1¼"	5¼"	48½"	C	1
I	center back slat	¾"	5"	18"	C	1
J	back slats	¾"	2½"	18"	C	10
K*	spacers	¾"	1"	1⅜"	C	24

Seat		FINISHED SIZE T	W	L	Matl.	Qty.
L	center rail	1¼"	3⅞"	17 3/16"	C	1
M	center cleat	1¼"	3⅛"	16 13/16"	C	1
N	end cleats	1¼"	3"	15¼"	C	2
O	front seat slat	¾"	2¼"	46¼"	C	1
P	seat slats	¾"	2¼"	50¾"	C	6

*Parts initially cut oversize. See the instructions.

Material key: C–cedar.

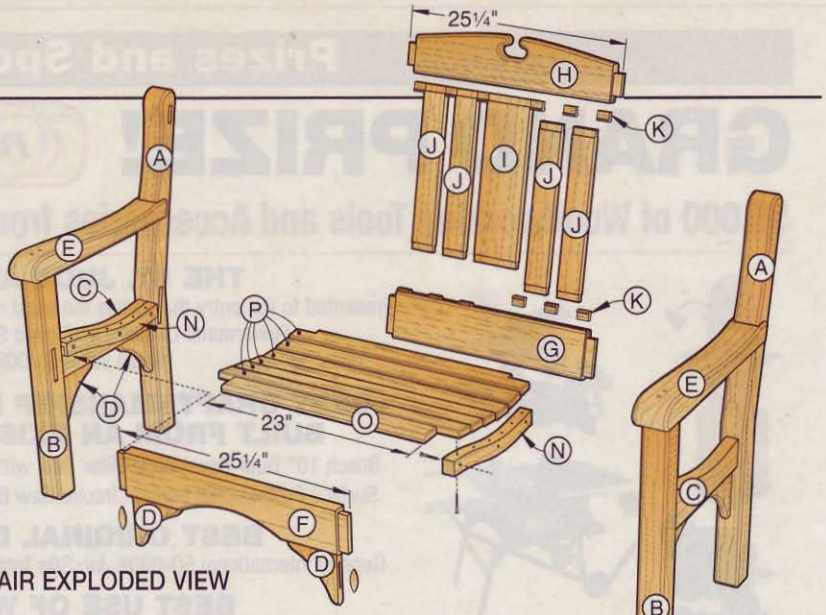
notch the slats. Now glue and clamp the front seat slats in place, apply a finish, and complete the assembly, as indicated for the bench.

Illustrations: **Roxanne LeMoine**

Chair Materials List

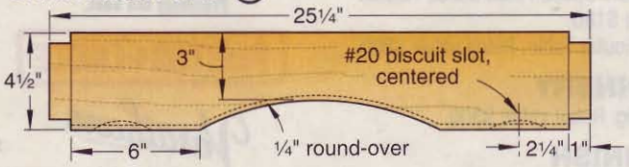
	Seat	FINISHED SIZE T	W	L	Matl.	Qty.
F	front rail	1¼"	4½"	25¼"	C	1
G	lower back rail	1¼"	5¼"	25¼"	C	1
H	upper back rail	1¼"	5¼"	25¼"	C	1
I	center back slat	¾"	5"	18"	C	1
J	back slats	¾"	2½"	18"	C	4
K*	spacers	¾"	1"	1⅜"	C	12
N	end cleats	1¼"	3"	15¼"	C	2
O	front seat slat	¾"	2¼"	23"	C	1
P	seat slats	¾"	2¼"	27½"	C	6

*Parts initially cut oversize. See the instructions.
Material key: C–cedar.

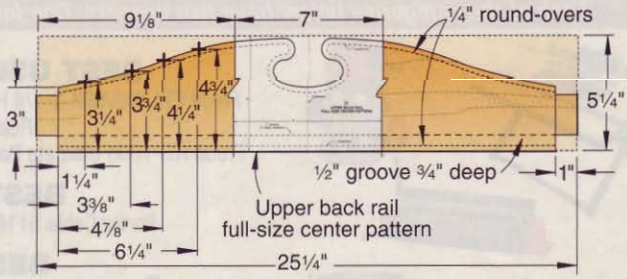


CHAIR EXPLODED VIEW

CHAIR FRONT RAIL (F)



CHAIR UPPER BACK RAIL (H)



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12" bandsaw betters many 14" saws, and for less $$

Most 14" bandsaws provide a good combination of power, resaw capacity, and price. No wonder, then, that 14" saws have become a shop staple. Now Craftsman comes along with a 12" bandsaw (model 22400) with ample power and more resawing capacity than most 14" bandsaws—at a price $100–$300 less.

The 22400's all-steel design looks like a shrunken-down version of the 16"–18" models we tested in issue 166 (November 2005). And yet it sports many of the same big-time features, including a blade-tracking window, wheel-cleaning brush, and dual dust ports: a 2½" port under the table and a 4" one behind the lower wheel.

I found the all-ball-bearing blade guides easy to set and adjust, and I like that the back of the blade rolls on the perimeter of the thrust bearing, instead of wearing a groove on its face. After setting up the saw, I used the included ⅜" blade to resaw stacks of 7"-wide hardwoods—the maximum capacity of the 22400—and I never felt that it struggled.

However, I struggled a bit with the included fence. It turns out that you use the same screws to adjust the fence perpendicular to the table and parallel to the blade. Unfortunately, I found a tweak in one plane messed up the alignment of the other, but eventually I got it perfect.

The huge 20⅜×15¾" cast-iron table runs on a wide aluminum trunnion for stability, and I had no problem with it deflecting while I worked. A built-in work light illuminated the work area nicely.

I was disappointed that the 22400 lacks a quick-release blade tensioner, although I guess it shouldn't have surprised me for the cost of this machine. And I wish, for resawing purposes, it would take a blade wider than ½".

—Tested by Randy Zimmerman

Craftsman 22400 12" bandsaw

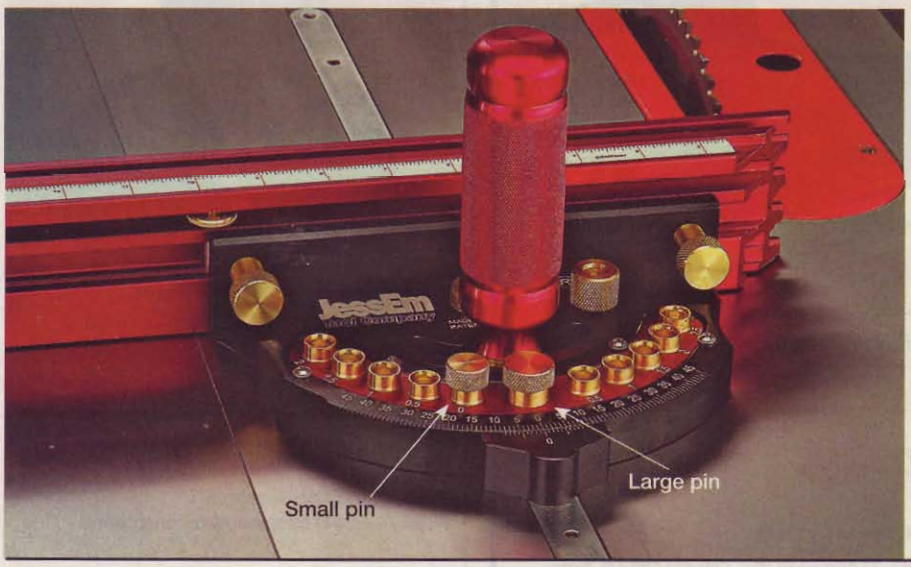
Performance	★★★★☆
Price	$300

Available at Sears stores.
800/377-7414; craftsman.com

Miter gauge built like a tank, with the finesse of a surgeon

I've always been impressed with the quality of construction and attention to detail in the design of JessEm woodworking accessories, such as their router lifts. So, when I got my hands on their Mite-R-Excel Precision Miter Gauge, I expected to be impressed. And I was.

The unique two-pin indexing system provides a positive miter stop every ½° from 45° left to 45° right. The large pin locks the miter-scale head at 5° increments, and the small pin offsets that angle by plus-or-minus 2½° depending on the hole into which you insert it. That took some getting used to, but proved absolutely dead-on in my tests. If you need some angle between, the vernier scale on the head shows 1/10° increments. You don't use the pins in this case, but they store right on the head.



At 27" long, with an extension that stretches its reach to 36", Mite-R-Excel's extruded aluminum fence covers most common crosscutting lengths used in furnituremaking. Instead of a flimsy plastic measuring tape, the repositionable cut-off scale in the top of the fence is mounted on a length of bar stock.

A real heavyweight in more ways than one, Mite-R-Excel tips the scales at 11 lbs, and taps the bank account to the tune of $220. That's more than some will pay, surely, but quality comes at a price.

—Tested by Charlie Bartlett

Mite-R-Excel Precision Miter Gauge

Performance	★★★★★
Price	$220

JessEm Tools
866/272-7492; jessem.com

continued on page 98

Plunge drill goes where you can't use a press

I've never been attracted to high-voltage cordless tools because 12- and 14.4-volt models have plenty of oomph for just about any woodworking task. But I'll make an exception for Triton's 18-volt Plunge Drill because it puts the precision of a drill press in the palm of your hand.

The spring-loaded plunge base on the snout of the drill locks out of the way for typical drilling chores. But when released and extended, it works similar to a drill press, keeping the bit perpendicular to the workpiece. I bored a series of holes while holding the plunge base against the workpiece and they measured as perpendicular as holes bored with my drill press. Drilling on a layout mark proved both accurate and repeatable.

Next, I set the TDC-100's depth stop so the bit would bore a little more than 1⅝" deep, and then marked both sides of a 3"-thick scrap so that holes drilled from opposite sides would meet in the middle. Then I did just that, using a 1" Forstner bit. The hole had a slight ridge where the cutting depth overlapped in the center of the scrap, but the offset was no more than produced on my drill press.

The TDC-100 comes with an edge guide for repetitive chores, such as drilling shelf-pin holes. I set the edge guide to drill 1½" from the edge, and the drill performed like a champ. An included V-base positions the drill to bore perfectly centered holes in curved faces, such as a dowel. Again, it worked at least as easily and accurately as my drill press.

But it won't replace a drill press—you can't, for example, mount a mortising attachment or bore through the center of a pen blank. Still, the TDC-100's portability provides precision in situations a drill press can't reach. Of course, this tool has all the standard features you'd expect in an 18-volt, variable-speed cordless drill: a two-speed gearbox, clutch, ½" keyless chuck, two batteries, and a charger.

— Tested by Pat Lowry

18-volt Plunge Drill TDC-100

Performance	★★★★☆
Price	$200

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www.arrowfastener.com Rev.1002

Ryobi AIRgrip accessories outperform its laser level

Five years ago, laser levels were high-dollar items used mostly by professional builders. But today, you'll find affordable laser levels practically everywhere, priced from $20 to $50. So what makes Ryobi's AIRgrip Laser Level+ different from a run-of-the-mill, low-dough laser level?

For one, the battery-powered vacuum base sticks like a suction cup to almost anything without marring. However, the vacuum base wouldn't grip an orange-peel-textured painted wall until I used it with the included rough-surface adapter. (I also used the adapter on a painted concrete block wall and varnished wood surfaces. It worked fine in both cases.)

On the orange-peel surface, I had trouble seeing the laser line beyond about 10', but it carried farther on smoother surfaces. Like most levels that use a small bubble vial, a little error reading the bubble multiplies by the time you get out 30'. Still, for short distances this unit fills the bill.

Dismount the level from the AIRgrip base, and the accessories that replace it add more value (and frankly, I found them more useful). For instance, I installed a handrail and found the Helping Hand attachment—a spring-loaded arm that spared my wife from holding the other end of the rail—a slick way to work with long workpieces. On smooth surfaces, its weight limit is 5 lbs. That's enough capacity for all but the longest crown molding.

The AIRgrip-mounted Multi-mag Tray puts a tool- and hardware-holding tray just about anywhere. Same with the three-LED light attachment (not shown) that illuminated the darkness under the sink while I worked there. Even the base by itself is handy: It sports tape measure slots and magnetic sides to hold a tape in place (again sparing my wife the trouble).

—Tested by Randy Zimmerman

AIRgrip Laser Level+ (EM0001)

Performance	★★★★☆
Price	$40

Ryobi Tools, sold only at The Home Depot
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plunge-router care and maintenance

10 top problems and how you can prevent them from happening

Replacing the carbon brushes that transfer power to your router is one of several simple fixes you can perform in your workshop.

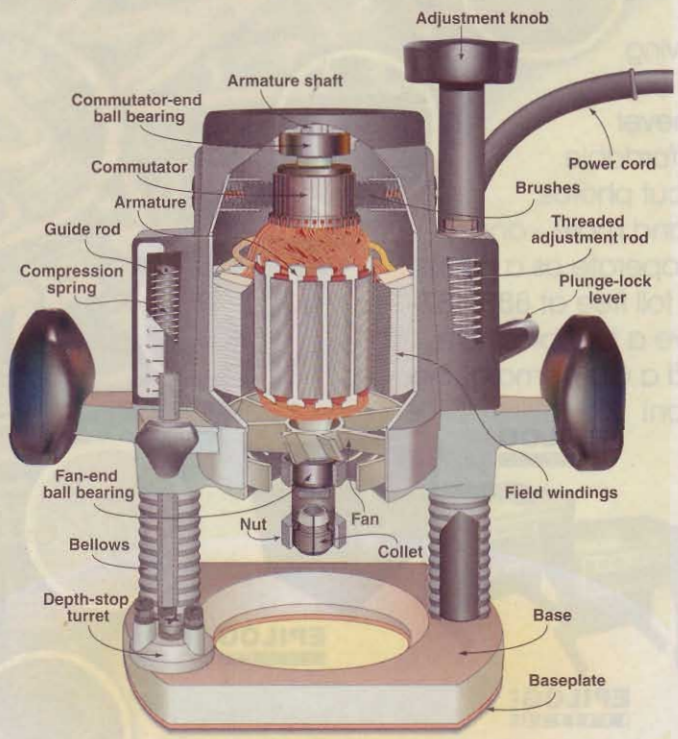
Considering their incredible versatility and flexibility, it's not surprising that the plunge router ranks as the favorite tool in many workshops. However, there's a price that comes with such popularity. After many hours of hard work, a few years of neglect, or perhaps an accidental fall off your bench, even the best-built router will need some TLC.

We narrowed the list of common plunge router problems down to 10. By learning what to look for, you can find and fix small problems, or know when it's time to send your tool to the repair shop. Ignore these problems and you could cause serious damage to your router, your next project, or even yourself. Because "an ounce of prevention is worth a pound of cure," we've also suggested a few items (shown *below*) for you to use to help your router perform at its best for years to come.

continued on page 102

Tool tour

Your router may look a little different from this example, but it contains the same basic parts. We've given you an inside view to help you understand how everything works. Just realize that some manufacturers advise against tackling any repair that requires you to remove the housing. Whether the repairs are done at home or in a repair shop, make sure to use replacement parts made for the brand and model of your tool. Substitutes will void the warranty and may damage other parts within the tool.



Your basic clean-machine kit

You only need to invest in a few items to keep your router running like a top for years. Cleaning is a prime time to inspect other parts and tighten loose screws.

1 Air compressor or canned air. Blowing through the air vents removes dust before it smothers the motor or cakes up electrical contacts. (Vacuuming works, too.)

2 Graphite or Teflon-type lubricant. Oily lubricants attract dust like magnets. Dry or spray-on lubricants offer slipperiness and rust resistance without sticky residue.

3 Wax. Works as both a cleaner for removing pitch, and as a lubricant for baseplates and guide rods. Apply sparingly, and then buff off excess with a dry cloth.

4 Toothbrush, brass brush, fine abrasive pad. Good for scrubbing away dust, light rust, or pitch, but be sure to use a gentle touch. Teflon-safe kitchen pads are the safest bets for cleaning collets and guide rods.

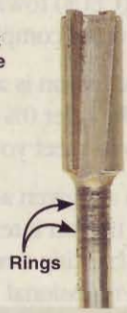
5 Pitch remover. These cleaners work on more than blades and bits. Use to remove baked-on crud on the baseplate and guide rods, but be careful around electrical contacts, lubricated bearings, and plastic parts.

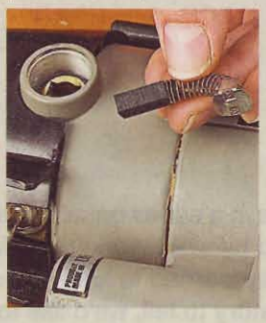
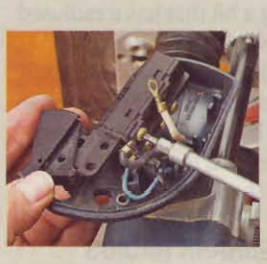
Sources

Brass collet brush set. No. 146736, $12.99. Top-Cote lubricant. No. 124624, 5.5 oz., $12.50. Woodcraft. Call 800/225-1153 or go to woodcraft.com.

Collet stretcher. No. 9464 for ½" router bits, No. 9468 for ¼" router bits, $24.95. **Dead man foot pedal.** No. 9080, $21.95. MLCS. Call 800/533-9298, or go to mlcswoodworking.com.

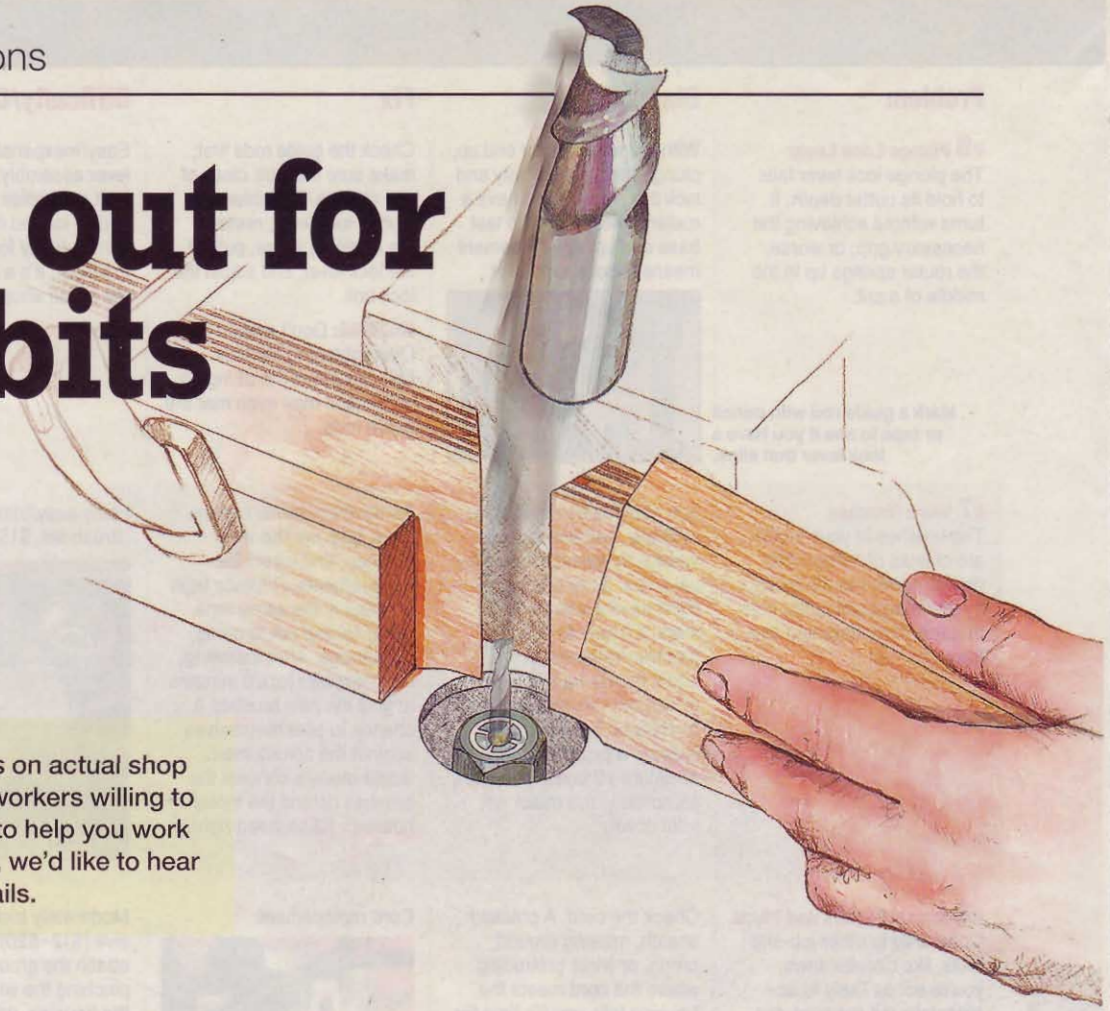
Plunge Router Troubleshooter

Problem	Diagnosis	Fix	Difficulty/Cost	Prevention
#1 Plunging Imperfections A smooth, comfortable plunge action makes for precise mortises and stopped cuts. A plunge action that stalls on the downstroke is annoying; one that sticks on the upstroke can be dangerous. **Disassembling the plunge mechanism isn't always necessary, but doing so makes it easier to clean and lubricate all the parts.**	Release the plunge lock and then test the plunge movement. General sluggishness usually points to pitch build-up. If you feel a sticking point, inspect the guide rods. You're likely to find a dent left by a slipped wrench, or by that short "ride" off your bench.	General sluggishness: Clean guide rods with a toothbrush or fine abrasive pad. Lubricate bars with dry graphite or Teflon-type spray. Don't use too much. Apply lubricant to your cloth, and then wipe the guide rods. Sticky spots: File or sand off the burr. Finish up by lubricating both rods. **WARNING:** Don't use grease or oil; it attracts dust that eventually will gum up the action.	Easy to Moderately Difficult/ Cheap ($0, assuming you already own some cleaning gear.)	Wipe off pitch, dust, and chips before they build up. Keep the bellows clean and uncracked; they'll keep crud from reaching the rods in the first place. For table-mounted routers, periodically disassemble the plunge mechanism to completely clean out sawdust.
#2 Banged-Up Baseplate The baseplate, or subbase, is the bearing surface between the tool and your work. Sticky buildup can hang up your router in mid-cut and burn an edge. A deep scratch can leave a sharp burr that will mar delicate surfaces.	Flip your router and run your fingers across the working face of the baseplate. Pitch streaks and burrs are tough to miss. Minor scratches are acceptable, but the baseplate should feel slick and smooth.	Pitch build-up: If you can't erase the crud with paste wax and an abrasive pad, try pitch remover. Wax the plate to make a smooth sliding surface. Burrs: Use a sanding block and 320-grit paper or a file to level any protrusions.	Easy and Cheap (Repairs $0; New baseplate, $0 if you make it yourself, otherwise $25) 	Make sure hardware, such as nails and screws, are countersunk below the surface before routing. Plan ahead for future mishaps by using a shop-made baseplate, or keeping a spare handy, just in case. **Use 320-grit sandpaper to remove scratches and dings from your baseplate before they leave nasty scratches on your work. Finish up with a light coat of wax.**
#3 Trashed Baseplate Most factory baseplate openings are sized to hold guide bushings. However, a large diameter bit can damage the retaining lip of the opening, making it too big to hold guide bushings.	You can't miss the smell of routed plastic. Plunging a large router bit into a baseplate's small opening results in tearing it up.	Replace the baseplate. **WARNING:** Make sure to use the correct screws. (When in doubt, contact the manufacturer.) Using the wrong screws will ruin the baseplate.	Easy and Cheap (Repairs $0; New baseplate, $0 if you make it yourself, otherwise $25)	Before turning on the router, take a test plunge. Invest in two baseplates: one for bushing-guided template work and another for big bits.
#4 Bits That Slip When a bit creeps out of the collet, regardless of how tight you torque the collet nut, you've got a problem. A slipping collet makes it impossible to rout a consistent cut and can damage the shanks of your bits. Even worse, it can fling the bit, creating a dangerous missile in your shop.	Dark marks, or rings, around the shanks of a bit are a solid sign that the bits are spinning slower than the motor. You can quantify collet wear by using a dial indicator to measure run-out, but first you should try wiggling the arbor to make sure it's not a bearing problem.	Remove pitch buildup or minor surface rust with a brass collet brush (see **Sources** on *page 100*). **WARNING:** Don't use sandpaper to make this fix. The collet/bit fit depends on thousandths of an inch. Sanding the collet or bit shank can remove too much metal and prevent a secure grip.	Easy/Inexpensive (New collet, $18–$20) **Two rings on this bit's shank indicate a loose collet. This bit is toast. Sanding off the damage reduces the shank size and affects the collet's ability to get a good firm grip.**  Rings	Keep the collet clean. Minor dust and rust can cause major damage. Blow or brush the collet out when changing bits. Sticking a bit out too far to make a deeper cut can increase leverage and widen the bottom portion of the collet. To prevent this "bell-mouthing," insert the shank as far into the collet as it will go, then back it out 1/16". Buy a collet stretcher (see **Sources** on *page 100*) to prevent overextending a bit.
#5 Frozen Collet Nut or Bit The reverse of bit slippage, a collet nut may lock onto the armature, or a bit may stick in the collet.	Try as you might, the bit refuses to come out. **A quick tap can break a collet's death grip on your bit. Once removed, clean and lightly lubricate the collet nut.**	Give the wrench a light whack. Make sure you're turning the nut in the right direction. Be careful not to damage the bit or the plunge rods in the process.	Easy to impossible, depending on how well the bit is stuck. If you think you might break something else in the process, take the tool to the repair shop. A new collet will cost around $20.	Do not overtighten the collet nut, or tighten the nut without a bit in place. To do so could permanently deform the metal. Clean threads with a toothbrush. Wipe on a thin coat of lubricant, and then wipe off any excess. **WARNING:** Do not lubricate the inside of the collet! If you do, it won't grip the bit.

Problem	Diagnosis	Fix	Difficulty/Cost	Prevention
#6 Plunge Lock Lever The plunge lock lever fails to hold its cutter depth. It turns without achieving the necessary grip; or worse, the router springs up in the middle of a cut.	With the router motor end up, plunge the base halfway and lock it in place. If you have a router table, repeat the test base end up. Any movement means a loose lock lever.	Check the guide rods first; make sure they are clean of any residue. To tighten the plunge lock lever, remove the retaining screw, pull off the lock lever, and adjust the lock bolt. **WARNING:** Don't overdo it! Overtightening the lock bolt can affect the plunging action and may even mar the guide rods.	Easy/Inexpensive. (New lever assembly, $20) This isn't a complex fix, but the spring-loaded mechanism can be tricky for first-timers to adjust. It's a quick fix for the repair shop.	If it ain't broke, don't fix it. Most lock problems can be traced to earlier attempts at a quick fix when the real problem may have been dirty guide rods or a slipping bit.
	Mark a guide rod with pencil or tape to see if you have a lock lever that slips.			
#7 Worn Brushes The brushes in your router are chunks of carbon that deliver current to the motor by brushing against the commutator. Over time and use, they wear out.	You may notice a decrease in power, see a shower of sparks, or detect an electrical smell. If the brushes don't have a wear limit mark, it's safe to assume that they're nearly at the end if there's less than ¼" of carbon. (Uneven wearing or chipped brushes may indicate a problem with the armature.) If one brush goes completely, the motor will shut down.	Remove the brush holder caps, take out the worn brushes, and insert the replacements. Replace both brushes at the same time, being careful not to crimp the springs. After installing, run the router for 20 minutes to give the new brushes a chance to seat themselves against the commutator. Some models conceal the brushes behind the motor housing. (Discussed *right.*)	Fairly easy/Inexpensive (Brush set, $15)	Average brush life varies from 50 to 100 hours. Even if you use your router regularly, you won't need to check the brushes more than once a year; pros may do a check every 6 months.
				**Marks of a good tool are brush caps for easy brush access. However, some routers require removing the housing to do this. In this case, take the tool to a repair shop.**
#8 Suspect Cords and Plugs Compared to other job-site tools, like circular saws, you're not as likely to accidentally cut the cord, but normal wear and tear still take their toll. At best, a damaged cord will kill your tool; at worst, it can kill you.	Check the cord. A cracked sheath, missing ground prong, or wires protruding where the cord meets the housing tells you it's time for a replacement.	Cord replacement.	Moderately tricky/Inexpensive ($12–$20). Failing to attach the ground wire, or pinching the wires under the housing, can make the tool potentially deadly to the user. Take it to the repair shop if you doubt your electrical abilities.	Choose routers with rubber cords—they maintain their flexibility longer than plastic. To avoid stressing the sheathing, wires, or connections, coil cords loosely, especially where they attach to the motor. Never yank a plug from the outlet or leave a plug where you could step on it.
	All appliances should be inspected for cracked cords and missing grounds. Replacement is cheaper than a trip to the ER.			
#9 Trigger Troubles More likely the result of a fall than mechanical failure, a switch that won't turn on or off deserves immediate attention.	The router fails to start or stop, or runs intermittingly.	The complexity of replacing a switch varies by model and manufacturer; if in doubt, take it to the repair shop. In the case of simple three-wire on/off switches, note the wire colors and locations before removing the old switch, and replace the new switch one terminal at a time. Be careful not to pinch the wires.	Somewhat tricky (depending on the model); Moderately inexpensive ($30 with labor).	Switches are tested to survive thousands of on-off cycles. You can minimize any further chance of problems by blowing out fine dust that can compromise electrical contacts.
 **Three-wire switches aren't hard to replace, but some variable-speed routers have six wires. When in doubt, leave this repair to the pros.**				
#10 Bad Bearings High-rpm routers are tough on bearings; but unless you're working in a heavy-use commercial shop, you may never encounter a problem. Bearings are designed to run for 300–400 hours; the rule of thumb is to replace them with every other brush change.	Worn bearings may make a popping, cracking, or grinding noise. Feel for heat. Rubbing bearings can raise a router's temperature and may even make it too hot to handle. To check your initial diagnosis, unplug the router and turn the arbor by hand. Any perceptible drag, wiggle, or looseness signals trouble.	Bearing replacement.	Difficult/Moderately expensive (about $50 with labor). Bearing replacement involves major disassembly. (They are press-fit onto the top and bottom of the shaft.) This job is best left to a repair shop.	Bearings wear out fast when they are not under load. Leaving the router on between cuts can be a problem with table-mounted routers. To avoid leaving the tool running, install a foot pedal (see **Sources** on *page 100*) to your router table so it's easy to switch off between cuts.

Written by **Joe Hurst-Wajszczuk**

watch out for loose bits



This is the first article in a series on actual shop mishaps experienced by woodworkers willing to share the lessons they learned to help you work safely. If you have a story to tell, we'd like to hear from you. See *page 106* for details.

The incident

I was using my table-mounted router to cut mortises in cabinet face-frame stiles when suddenly the ¼"-diameter upcut spiral bit began to chatter loudly. Without shutting off the router, I lifted the stile off the table and immediately felt something tick me on the right cheek. I then shut off the router, and rubbed my cheek to check for what I thought was a splinter.

I didn't find anything but, through my peripheral vision, I saw something sticking out of my forehead between my nose and right eyebrow. Assuming it was a piece of wood, I grabbed it with my handkerchief and pulled it out. I couldn't believe it was the bit! I guess it had glanced off my cheek.

After covering the wound, I drove to a hospital. Fortunately, although the bit penetrated ⅝", an X-ray showed no sign of serious injury, so the opening was sutured.

The next morning, I checked the router and bit and found the nut tight on the collet and no sign of damage on the bit shank. I really don't know what caused the problem. The 12-year-old router now resides in a landfill, but I carry the bit with me everyday as a lucky charm.

—Clark Mittan, Waldorf, Md.

The woodworker

With more than 40 years of experience, Clark is a professional woodworker specializing in cabinetry and housing restoration work in the District of Columbia area.

The warning signs

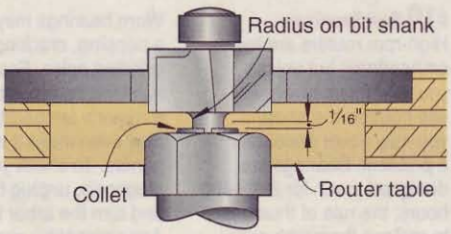
The chattering that Clark heard signaled that something was loose in the router, requiring immediate shutdown and inspection. Rather than lifting the workpiece, Clark realizes in hindsight that he should have held it in place to safely contain the bit while turning off the router. Also, he was not wearing safcty glasses, which might have deflected the bit from his face and prevented a more serious injury if it had hit his eye.

The lessons

A loose router bit can become a dangerous projectile, as Clark learned, and it also can affect the accuracy of your cuts. Although it's not clear what caused Clark's bit to loosen, here are a number of things you can do to prevent the problem.

- Use only sharp bits. Dull cutting edges increase force and stress on the bit and router collet, which can cause slippage.
- Before you install a bit, make sure the shank and collet are free of sawdust, grease, and other contaminants. Also, check the collet and bit shank for rust and damage, such as scoring, which can create burrs that prevent sufficient collet grip. If you see any corrosion or damage, replace the collet and/or bit, as appropriate.
- When installing a bit that has a radiused transition area between the cutter and shank, insert the shank into the collet until it bottoms, and then pull the bit out enough to clear the radius by about 1/16", as shown *below*. This ensures that the collet clamps tightly around the shank.

CLEARING A BIT-SHANK RADIUS



continued on page 106

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safety: real-life lessons

- Using the router-supplied wrenches, tighten the collet nut firmly. Never tighten the nut without a bit inserted or you may damage the collet.
- Never exceed the maximum speed specified by the bit and router manufacturers. Use the chart *below* as a guide for speed based on bit diameter.

MAXIMUM ROUTER SPEED

Bit diameter	Max. speed (rpm)
Up to 1"	Up to 24,000
1 to 1¼"	16,000 to 18,000
1¼ to 2¼"	12,000 to 16,000
2¼ to 3½"	12,000

Note: Maximum speed of fixed routers is typically 24,000 rpm. When using bits larger than 1" diameter, we recommend using a variable-speed router.

- When you need to remove a lot of material, make multiple shallow passes to minimize stress on the bit and collet.
- Listen to the router. If you hear it straining, you're removing too much material or feeding the workpiece too fast.
- When routing multiple pieces, occasionally shut off the router and measure the bit height to ensure it has not changed.
- Always wear eye protection and, whenever possible, use a bit guard.

Earn $100 for your story

Help other readers work safely by sharing a personal shop-related mishap or near miss. Send a detailed narrative of the incident (about 150 words), along with photos or illustrations and a daytime phone number, to: Safety: Real-Life Lessons, *WOOD* Magazine, 1716 Locust St., LS-221, Des Moines, IA 50309-3023. Or e-mail us at safety@woodmagazine.com. **If we choose your story for publication, you will receive $100.**

Illustration: **Roxanne LeMoine**
Opening illustration: **Melanie Powell, Studio in the Woods**

what's ahead

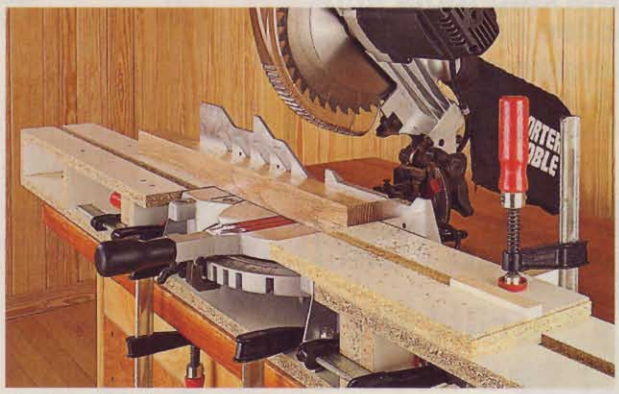
Check out the articles in the September issue (on sale July 18)

Projects for your home and shop

FEATURED PROJECT

Heirloom bookcase

This stunning piece will surprise you with its simple joinery: biscuits, dadoes, grooves, and rabbets for the upper and lower cases, and sliding dovetails for the drawers. Even the cabriole legs are easy to shape.



No-sweat mitersaw or mortiser base

You'll invest little time or money in these super-handy extension tables and stop, so build a set for each tool. Or swap your mitersaw and mortiser in and out of one set of extension tables for space savings.

Soaring eagle

With just a scrollsaw and some sanding, you can build this proud flyer. You can up-size its 24" wingspan to fit your needs.

check out this simple miter-clamping jig!

Tabletop curio case

Showcase smaller collections in this compact display cabinet with easy-access side door.

Tools and techniques

Hand tools for the power tool junkie

Okay, okay, we're hooked on power tools, too, but there are some hand tools you just shouldn't live without. Here's how to use 'em.

In the groove

Learn to cut dadoes, grooves, and rabbets for joints that hold tight and look great, using a router or tablesaw.

Polyurethane perfection

Looking for better results and easier application from this durable finish? These tips will spell your success.

TOOL TEST

Router lifts

Want more accuracy and convenience from your router table? Don't miss this review.

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